8-A-S

COUNTER / TIMER

INSTRUCTION MANUAL

VIKING LABORATORIES INC.

SD 1033
5 MHz Counter-Timer

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SERIAL NO.

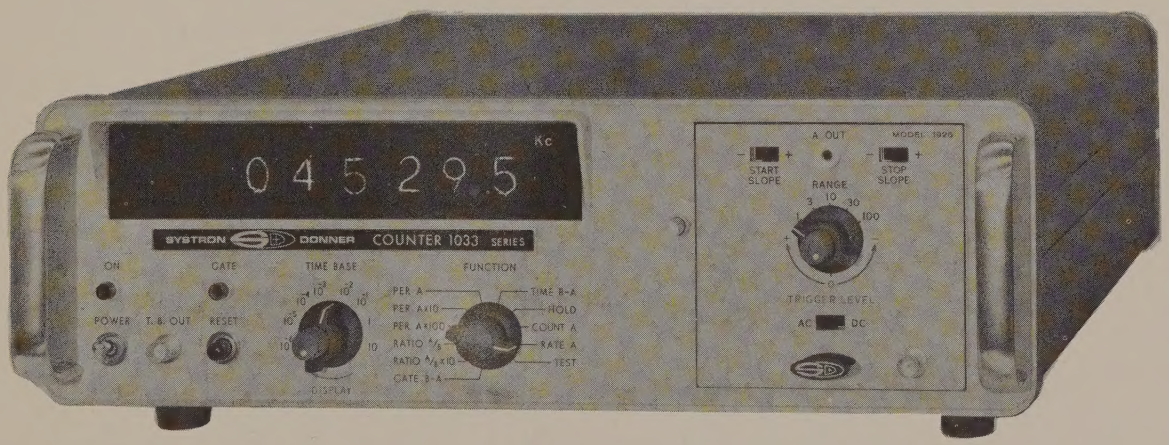
VIKING LABORATORIES INC.

DATE

MODEL 1033

5 MEGACYCLE

COUNTER–TIMER



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ADDENDUM

MODEL 1033 and 1034
FREQUENCY COUNTERS

Paragraph 2.8 of this manual is in error. The paragraph should read:

> The basic counter is furnished without a plug-in unit. A plug-in must be installed for normal operation of the unit. If a plug-in is not installed, or a blank plug-in is installed, electrical connections will not be completed and the instrument will not function.

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Chapter 1 — GENERAL DESCRIPTION

1.1 FUNCTIONS

The Model 1033 Counter-Timer is a solid-state instrument of 5 megacycle range which is capable of all basic modes of frequency and time interval measurements and pulse counting when used with the appropriate plug-in unit. Its normal measuring range extends to time intervals as short as 1.0 microsecond (in increments of 1.0 microsecond) and to frequencies as high as 5 megacycles per second. With the universal Model 1926 front-end plug-in module, all measuring functions are available, including RATE (frequency), COUNT, HOLD, TIME (interval), PER A, PER A x 10, PER A x 100, RATIO $A/_B$, RATIO $A/_B$ x 10, GATE B-A. In addition, a TEST function is provided as a self-check for all counting circuitry.

There are six other plug-ins in addition to the Model 1926, available for use in the Model 1033. The functions and brief characteristics of each are given in Table 1.3. Complete specifications for the Model 1926 Universal Time Interval plug-in are given in Table 1.4.

1.2 STANDARD FEATURES

The Model 1033 is designed for simple, reliable operation, and easy maintenance. Its circuitry is fully transistorized. The Models 1924, 1925, 1926, 1926A and 1944 units employ a single "Nuvistor" tube in the input amplifier for high input impedance and sensitivity, which reduces circuit loading and permits a wide selection of signal sources.

Other features include compact modular construction, in-line readout (six digits) with bi-quinary indicators*, and low power consumption. The circuitry is designed with a wide range of outputs from the time base generator and versatility of controls to achieve speed and accuracy in all measurements.

The time base generator output is available at a rear connector for use as a secondary standard. The stability of the crystal oscillator in the time base is maintained by an oven to within ±3 parts in 10^7 per week. A rear switch selects either display or blanking during the count cycle.

1.3 OPTIONAL FEATURES

A wide variety of optional features are available for adapting the Model 1033 to many custom requirements. The "D" option series provides decimal or binary-coded outputs compatible with digital date systems. Other options include 7-digit display (Option E), two ultra-stable oscillators (Options B and B3) and display storage during the subsequent counting period (Option S).

Table 1.2 gives a more detailed summary of the optional features available for the Model 1033.

* "BI-QUI'S" AMPEREX TRADEMARK

1.4 TECHNIQUE

The Counter-Timer uses time-proven techniques of digital frequency and time measurement. In frequency measurement, the signal is applied to an electronic register of seven decade counting stages, connected in series, for a precisely controlled length of time. The indication of the decades at the end of the time is the number of cycles of the input which occurred during that time; if the time is one second, the indication may be read directly in cycles per second. In time measurements, the arrangement is reversed and the decade register is used to count a precise frequency from the time base generator during an interval controlled by the external signal (or signals). In this case, the interval or period of the applied signal = 1/f.

Additional control circuitry holds the indication of the counters for an adjustable length of time and then automatically resets the instrument to zero in preparation for the start of a new counting interval.

1.5 APPLICATIONS

The Model 1033 Universal Timer and Counter can be employed for measurement, analysis, and counting of both periodic and random signal pulses of arbitrary wave-shape within the rated frequency characteristics of the instrument. Because it operates directly from voltage inputs, it is an indispensable tool for designing, manufacturing, and testing of instruments and circuits having an electrical output relating to time interval, frequency, and number of occurrences. It is commonly used for the design and calibration of transmitting and receiving equipment, oscillators, tuned circuits, crystals, etc. Because of its accuracy and stability, it is invaluable for checking long-term drift and heat-cycling stability of crystals and other signal generators. Other common applications are calibration of resolvers and synchros, and measuring gain-phase characteristics of closed loop servo systems.

When employed with suitable input transducers, such as photo cells, magnetic pickups, or switches, it becomes equally valuable for measuring physical events with respect to time, for example: speed of rotation, flow rate, time delays, or production unit counting. A list of typical applications includes:

Frequency measurements
Relay and switch timing
Viscosity and ballistic measurements
Elasticity measurements
Tachometry
Telemetry
Pulse height and width analysis
Oscilloscope time base calibration
Flow, Strain, Force, Pressure measurements
Radiation counters

CAUTION

Do not insert or remove plug-in units with Power On.

Table 1-1 Model 1033 Counter Specifications

FREQUENCY MEASUREMENTS

RANGE: 0 to 5 Mc (DC input). 10 cps to 5 Mc (AC input, maximum sensitivity).

SENSITIVITY: 100 mv rms or better from 0 cps to 5 Mc.

GATE TIME: 1 μsec to 10 seconds in decade steps.

ACCURACY: ±1 count ± time base accuracy.

READS IN: kc or Mc with positioned decimal point; units annunciator in line with digital display.

SELF CHECK: Counts 1.0 Mc for the gate time chosen by the time base selector switch.

EXTERNAL SCALING

FREQUENCY RANGE: 10 kc to 2 Mc.

FACTOR: By decades up to 10^6, switch selected on front panel.

INPUT: Rear panel.

OUTPUT: In place of time base output frequencies.

SENSITIVITY: 1v rms.

PERIOD AVERAGE MEASUREMENTS

RANGE: Single Period . . . . . 0 to 1 Mc
Multiple Period. . . . . 0 to 1 Mc

PERIODS AVERAGED: 1 period to 10^2 periods in decade steps.

ACCURACY: ±1 count ± time base accuracy ± trigger error<*.

FREQUENCY COUNTED: 1 cps to 1.0 Mc in decade steps.

READS IN: Sec, ms, μs, with positioned decimal point; units annunciator in line with digital display.

RATIO MEASUREMENTS (Using Rate Function)

DISPLAYS: (f_1/f_2) times multiplier x 10^6

RANGE: f_1. . . . 0 to 5 Mc. f_2. . . . 10 kc to 2 Mc.
Ratios averaged 1 to 10^7 in decade steps (selected by Time Base switch).

SENSITIVITY: 0.1v rms, f_1 input, 1v rms f_2 input.

ACCURACY: ±1 count of f_1 ± trigger error * of f_2. f_1 is frequency applied to the decimal counters (enters A input jack on front panel). f_2 is frequency applied to decade dividers (enters EXT Time Base jack on rear panel).

**Trigger error is less than ±0.3% of one period ÷ periods averaged for signals with 40 db or better signal-to-noise ratio.*

READS IN: Dimensionless; annunciator and decimal point not applicable.

TIME BASE

FREQUENCY (internal): 1 Mc.

STABILITY: Aging Rate—less than 3 parts in 10^7 per week after 1 hour warm-up. As a Function of Temperature—less than ±2 parts in 10^6 per °C from +20°C to +55°C. As a Function of Line Voltage—less than ±2 parts in 10^8 for ±10% change in line voltage from 115v or 230v rms.

SHORT TERM—less than 1 part in 10^8 rms with measurement averaging time of one second under constant environmental and line voltage conditions.

ADJUSTMENT: Range approximately 4 parts in 10^5 available from top of crystal oven.

OUTPUT FREQUENCIES: Rear panel; 1 Mc sinewave 1v rms minimum, available uninterrupted in all functions. Output impedance 1000 ohms nominal.
Front Panel; 0.1 cps to 1.0 Mc in decade steps selected by time base switch, 470 ohm output impedance, 6v p-p rectangular wave form. Stability of both outputs same as internal time base.

EXTERNAL STANDARD FREQUENCY: 1 Mc, 1 volt rms into 1000 ohms required at rear panel BNC connector.

GENERAL

REGISTRATION: 6 digits in-line, 999,999 maximum display; total width of 6 digit display including illuminated units annunciator and autopositioned decimal point indication does not exceed 8½ inches.

SAMPLE RATE: Time following a gate closing during which the gate may not be re-opened is continuously variable from less than 0.2 sec. to 5 seconds in frequency mode, independent of gate time; display can be held indefinitely. Manual reset by front panel pushbutton.

OPERATING TEMPERATURE RANGE: –20°C to +65°C.

STORAGE TEMPERATURE RANGE: –55°C to +85°C.

DIMENSIONS: 5¼" high by 16⅞" wide by 17" deep.

WEIGHT: Net, 33 lbs. shipping, 52 lbs.

POWER SUPPLY: 115 or 230 volts ±10%, 50 to 60 cps; 125 watts.

ACCESSORIES FURNISHED: S-D #2702 Coaxial cable 6 feet long, male BNC one end.

Table 1-2 Model 1033 Options and Special Features

OPTION B: High Stability Oscillator

AGING RATE: Better than 1 part in 10^9 per 24 hours.

WARM-UP TIME TO REACH AGING RATE SPECIFIED: Within 30 hours.

ACCURACY 1 HOUR AFTER TURN-ON REFERENCED TO PREVIOUS TURN-OFF FREQUENCY: Better than 5 parts in 10^9 absolute.

SHORT TERM STABILITY AVERAGED OVER 1 SECOND: 1 part in 10^{10} rms.

VARIATION WITH TEMPERATURE: –20°C to +25°C—Less than ±9 parts in 10^9 (average ±2 parts in 10^{10} per °C).
+25°C to +55°C—Less than ±6 parts in 10^9 (average ±2 parts in 10^{10} per °C).

VIBRATION 5 to 55 cps, 0.016" DA: ±2 parts in 10^8 meets MIL-STD-167.

SHOCK 50 G, 11 milliseconds: Less than ±1 part in 10^8 MIL-STD-202A.

FOR ±10% CHANGE IN LINE VOLTAGE: Less than ±5 parts in 10^{10}.

STORAGE TEMPERATURE: –65°C +85°C.

LONG TERM AGING RATE: Better than 3 parts in 10^8 per 30 days.

AFTER APPROXIMATELY 60 DAYS CONTINUOUS OPERATION-AGING RATE: 2 parts in 10^{10} per 24 hours.

ADJUSTMENT: Fine frequency adjustment (range approximately 4 parts in 10^8) and coarse frequency adjustment (range approximately 4 parts in 10^6) are available from the front panel through the plug-in hole.

OPTION B_3: HIGH STABILITY OSCILLATOR

Aging Rate: Better than 3 parts in 10^9 per 24 hours.
Warm-up time to reach aging rate specified: Within 72 hours.
After approximately 60 days continuous operation-aging rate:
3 parts in 10^9 per 24 hours.
Short term stability averaged over 1 sec.: 2 parts in 10^{10} rms.
Variation with Temperature: –20° C to + 25° C
+25° C to + 55° C
Less than ±9 parts in 10^9
(average ±2 parts in 10^{10} per ° C)
Less than ±6 parts in 10^9
(averaged ±2 parts in 10^{10} per ° C)

For ± 10% change in line voltage: Less than ±5 parts in 10^{10}
Storage Temperature: –55° C to +85° C
Long term aging rate: Better than 2 parts in 10^8 per 7 days.

OPTION D: 10-line Digital Output

9 lines at +30 volts min. at 1 megohm source impedance.
1 line at 0 volts at 1 megohm source impedance.
PRINT COMMAND: +30 volts to 0 step, DC coupled.
CABLE CONNECTOR: Amphenol 50 pin 57-30500, 2 required.
INHIBIT REQUIREMENTS: Closure to ground.
REFERENCE VOLTAGE: +25 volts, 1000 ohm impedance.

OPTION D1: 1-2-4-8 BCD Digital Output

Positive Logic
"0" State level at –6V at 5.6 K ohm source impedance.
"1" State level at 0V at 5.6 K ohm source impedance.
PRINT COMMAND: +30V to 0V step, DC coupled.
INHIBIT REQUIREMENT: Closure to Ground.
CABLE CONNECTOR: Amphenol 50 pin 57-30500, 1 required.

OPTION D2: 1-2-2-4 BCD Digital Output

Positive Logic
Suitable for operating with H-P 562A with Option 12 or 14 and with Beckman 1453 Printers.
"0" State level at 0V, 0.5 ma, maximum to ground.
"1" State level at +30V, 100 K ohm source impedance.
PRINT COMMAND: +30V to 0V step, DC coupled.
INHIBIT REQUIREMENT: Closure to Ground or 562A circuitry.
REFERENCE LEVELS: +23 volts, 1 K ohm source impedance.
+6 volts, 1 K ohm source impedance.
CABLE CONNECTOR: Amphenol 50 pin 57-30500, 1 required.

OPTION S: Display Storage

Holds reading between samples; switch overrides storage on rear panel. This provides a continuous display of the most recent measurement. This display is held even while the instrument is gated for a new count. If the new count differs from the stored count, the display will shift to the new reading directly.

Table 1-3 Interchangeable Plug-ins for the Model 1034

Model Designation	Primary Use	Frequency Range	Characteristics
1926A Time Interval	Time interval measurements. Also used for period, pulse-width, and gated signal measurements.	DC to 10 Mc 0.1 μsec resolution 1 μsec to 10^8 sec	0.3 volt p-p input sensitivity. Compensated five-position step attenuator, separate start-stop slope selection.
1924 Dual Measurement	Performs all functions of 1926A plus automatic switching for alternate measurement of two input frequencies.	DC to 10 Mc 0.1 μsec resolution	Same as 1926A above.
1936 DVM	Measures DC voltage 0.1 volt to 100 volts.		Accuracy is ±0.025%. Reads voltage to six digits.
1944 Preset	Permits highly variable adjustment of time base for readout in engineering units: rpm, gpm, fps, lb. per hour, etc.	same as counter	Preset N from 00001 to 99999 to normalize rate (frequency), ratio and count N events.
1979 Prescaler	Frequency measurement or scaling of sine-wave or pulse type inputs.	100 Kc to 50 Mc	Input signal 100 mv rms to 1 volt rms. Pulse pair resolution 10 nanosec. Counter reads 1/10 input.
1948A Video Amplifier	Amplification of low level signals.	10 cps to 50 Mc	Input: 1 mv rms to 300 mv rms Input Impedance: 1 megohm Requires H Mod.

Specifications subject to change without notice

Chapter 2 — INSTALLATION

2-1 INITIAL INSPECTION

2-2 As soon as the counter is received, verify that the instrument is intact and as ordered. Inspect the counter for any physical damage such as scratched panel, broken knob, or bent connectors. If damage is found, refer to the warranty (inwardside of rear cover) and Paragraph 2-5 for shipping and repackaging instructions.

2-3 STORAGE AND RESHIPMENT

2-4 Environmental conditions during storage and shipment should be limited as follows:

a. Maximum temperature 185° F (85° C)
b. Minimum temperature −69° F (−55° C)

2 5 To protect your instrument during shipment or storage, use the best packaging methods available. Your Systron-Donner field office can provide materials similar to those used for original factory packaging. Contract packaging companies can provide dependable custom packaging on short notice.

a. If possible, use the original container designed for the instrument. Otherwise, use a strong carton (350 lb sq inch bursting strength) or wooden box to house the instrument.

b. Wrap the instrument in heavy paper or plastic before placing it in the shipping container.

c. Use plenty of packing material around all sides of the instrument and protect the front panel with card board strips.

d. Seal the package with strong tape or metal bands. Mark with "Delicate Instrument."

e. Refer to the warranty page at the rear of this manual and check with Systron-Donner field office for shipping instructions. All correspondence should refer to an in strument by model number and the full, serial number.

2-6 INSTALLATION

2-7 ***Counter Rack Mounting.*** All Systron-Donner counters are shipped in a fully operable condition and are accompanied with a kit to allow rack mounting if desired. If rack mounting is desired, install rack mounting adapters as follows: (See Figures 2-1 and 2-2)

a. Remove metal strip(s) from counter side panel channels, after removing rear hold down bracket(s).

b. Remove bottom dust cover and unscrew studs mating rubber feet to the counter stand and bottom panel.

c. Remove rubber feet stand mounting plate and collapsible stand.

d. Install 17125 adapter in mounting holes in each side of counter using H1305 screw, H0748 nut and H0658 washer.

e. Replace counter covers and connect counter to AC power source (See paragraph 2-9).

2-8 Plug-in Modules.

The basic counter is furnished with a plug-in module unit. The plug-in module must be installed prior to operating the counter to complete electrical connections and to provide proper air flow through the counter.

2-9 POWER REQUIREMENTS

2-10 The counter can operate from 115V or 230V ±10%, 50 to 60 cps. It is normally supplied for 115V operation to convert power supply from 115V to 230V. Remove jumpers between rectifier board pins 3-4 and 1-2 on primary side of power transformer T-1. Install jumper between pins 2-3.

2-11 COOLING

2-12 The counter uses forced air cooling provided by a fan mounted on the inside rear panel.

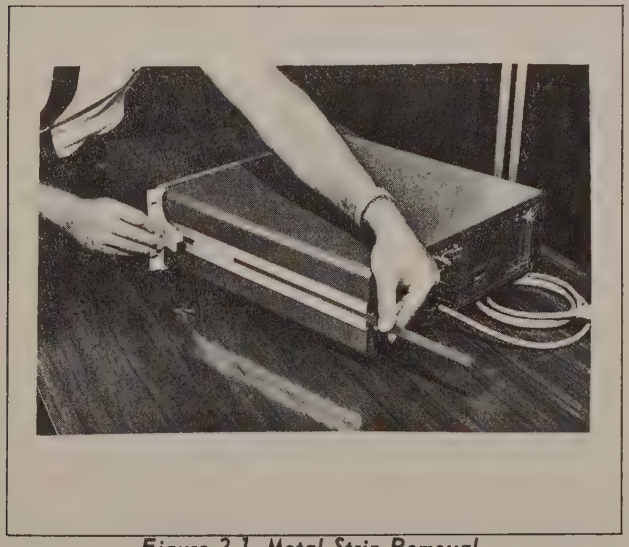


Figure 2-1 Metal Strip Removal

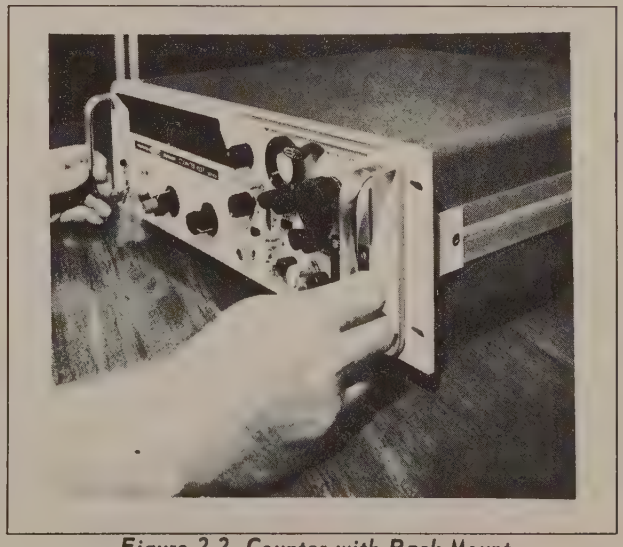
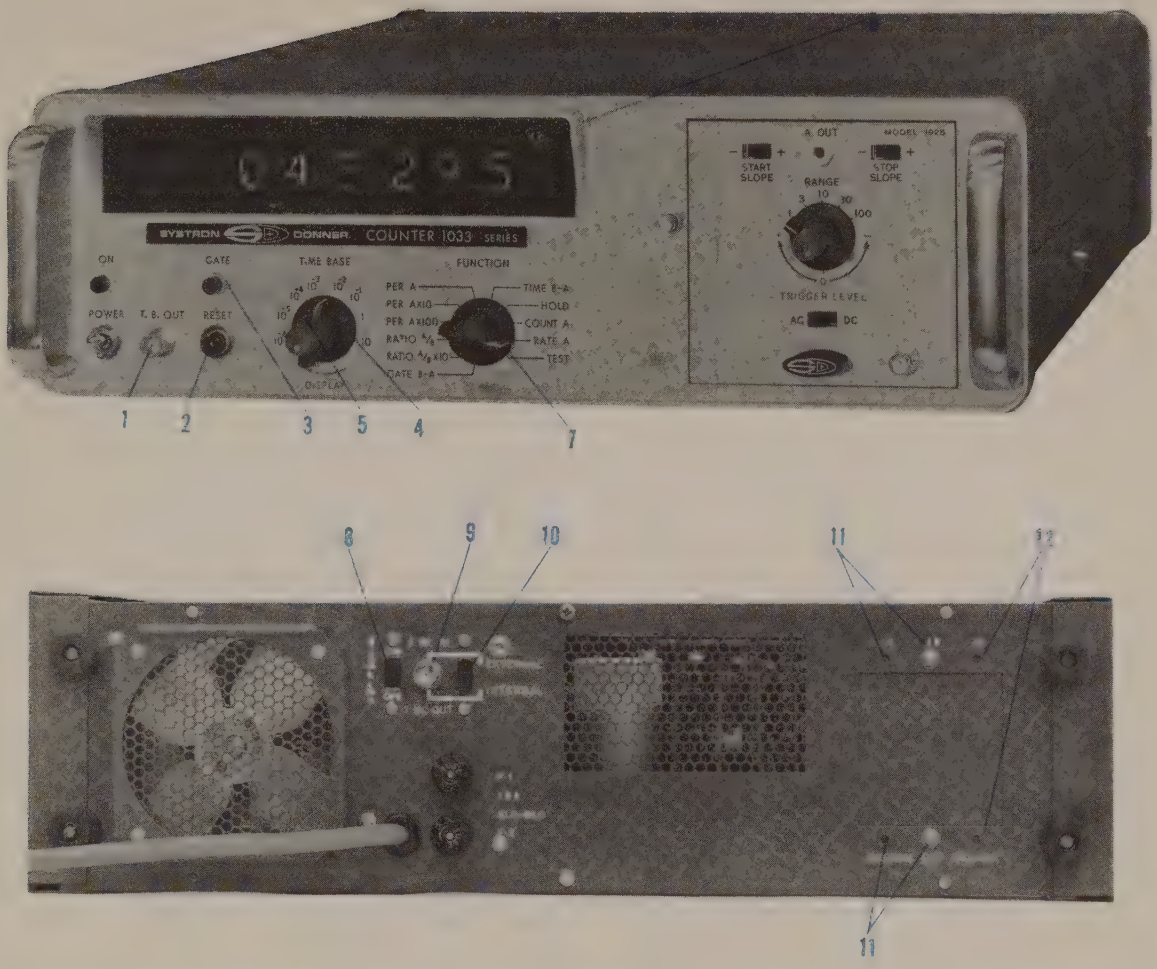


Figure 2-2 Counter with Rack Mount



1) T.B. OUT: Time base output in decade steps from 0.1 cps to 10 Mc selected by Time Base switch, 470 Ω output impedance, 6 volt p-p rectangular waveform, stability same as internal time base.
2. RESET: Manual reset pushbutton.
3. GATE LIGHT: On when gate is open.
4. TIME BASE: Outer knob selects time base from 10 sec to 10^{-7}
5. DISPLAY: Inner knob selects display time variable from 0.2 sec to 5 sec and infinte.
6. READOUT: 7-digit in-line indicators with units annunciator and decimal point.
7. FUNCTIONS: Test is a self-check of counting circuitry with 10 Mc internal signal.
   RATE A: Measures frequency by counting each cycle during selectable time base period.
   COUNT A: Totalizes number of cycles applied to A input.
   HOLD: Turns gate off manually.
   TIME B-A: Measures time interval between signals applied to A and B inputs of Models 1926A, or 1924 plug-ins.
   PER A: Measures period of one cycle of input waveform applied to A input of 1926A, 1924 or 1944 plug-ins which provide complete input adjustment controls.
   PER A x 10: Same as PER A but measures 10 cycles of input frequency.
   PER A x 100: Same as PER A but measures 100 cycles of input frequency.
   RATIO A/B: Counts number of cycles at A input during one cycle at B input of 1926A, 1924, or 1944 plug-ins.
   RATIO A/B x 10: Same as RATIO A/B but for 10 cycles at A input.
   GATE B-A: Counts number of cycles at GATE input during time interval between A & B inputs of 1926 plug-in.
8. BLANKING/STORAGE ON-OFF SWITCH: Blanks indicators during count cycle so that only answers are displayed. Counters with options hold previous indication until next measurement is completed.
9. 1MC JACK: BNC connector for 1 Mc input when EXTERNAL-INTERNAL switch is in EXTERNAL position or 1 Mc output for external use when switch is in INTERNAL position.
10. EXTERNAL-INTERNAL SWITCH: In internal position the 1 Mc signal generated in the counter is used for the counter time base and is also available at the rear panel BNC connector as an output signal. In the external position the internal 1 Mc signal is disconnected from the BNC connector and the time base and an external 1 Mc signal must be connected to the rear panel BNC connector.
11. J4, J5 D OPTION: Connector locations for interconnecting cable to printer.
12. J6, D1 or D2 OPTIONS: Connector location for interconnecting cable to printer.

Figure 3-1 Front and Rear Panels of Model 1033 Counter

Chapter 3 — OPERATION

3-1 INTRODUCTION

This chapter contains the operating procedures for use of the counter and use of the Model 1926 Universal plug-in. Use of Models 1926A and 1925 plug-ins is similar to that described. For detailed operation descriptions of the plug-in units refer to the manual supplied with them.

3-2 USE OF COUNTER CONTROLS, INDICATORS, AND CONNECTORS

3-2-1 Power: The counter is ready to test approximately one minute after the Power switch is turned on, provided that it has been connected to a source of power for at least one hour to allow the oven-controlled oscillator to reach stabilization.

3-2-2 Time Base Selector: This switch selects one of the nine time base output frequencies which are used as the time reference for the RATE, PERIOD, or TIME Interval measurements. They range from 0.1 cycles to 10 megacycles per second in decade steps, corresponding to time units of 10 seconds to 0.1 microsecond. This switch also controls the automatic decimal point indication in terms of kilocycles-per-second, or megacycles-per-second for measurements in the RATE function, and in terms of seconds, milliseconds, or microseconds for measurements made in the PERIOD or TIME Interval functions, as indicated by the annunciator located directly to the right of the readout. (NOTE: An asterisk (*) indication denotes that the positions of the time base and function switch are such that a valid measurement can not be made.)

For maximum accuracy in measurements involving the time base, use the time base selector position which results in the largest count on the indicator; that is, for relatively high frequencies, use the RATE mode with the TIME BASE selector in the 10 position (extreme clockwise). For relatively low frequencies, use the PERIOD, PERIOD x10, or PERIOD x100 mode with the 0.1 microsecond time base.

If maximum accuracy is not required, it will be more convenient to read the indication if the time base is changed to produce a smaller count.

3-2-3 Function Selector: Set this switch to the desired position according to the discussions in the sections on Principles of Measurement. Use the x10 or x100 positions when it is desired to extend the PERIOD or RATIO, measurements for better accuracy.

3-2-4 Display—Reset: The DISPLAY control (concentric with the Time Base switch) is used to vary the duration of the count display over a range of approximately 0.1 to 15 seconds before the instrument is automatically reset for the next measurement cycle. When the indication is small or relatively constant from one measurement to the next, the minimum display time may be used. For varying counts, a longer display time is necessary to allow time for reading.

In the extreme clockwise position, the display will remain until the RESET button is pressed. It is advisable to use this position when measuring non-recurrent quantities.

3-2-5 Blanking-Storage: If it is desired to blank out the display during the counting cycle so that only the final count is displayed, turn on the BLANKING switch found at the rear of the instrument. On instruments having Option S, the same switch operates the display storage feature, which holds the final count indication until the end of the succeeding count cycle.

3-2-6 Internal-External Time Base Reference: Normally the counter is operated with the rear switch in the INTernal position. A one megacycle output signal is available at the adjacent 1 Mc jack for use as a frequency standard for auxiliary equipment. If it is desired to operate the counter-timer from an external reference frequency, as when making simultaneous measurements with two instruments, change the switch to EXTernal position and apply the external one megacycle reference to the same rear 1 Mc jack.

The external signal should be between 1 and 10 volts rms in amplitude. The time base selector will function with the external reference in the same manner as with the internal reference.

3-2-7 Time Base Output Jack: The time base frequency selected by the TIME BASE selector switch is available at this front panel jack. (10Mc to 0.1 cps in decade steps.)

3-2-8 1 Mc Output Jack: Located on the rear panel, this jack provides a 1 Mc, 1 v rms output, or with the INT-EXT switch in EXT it will accept a 10Kc to 2Mc, input signal (amplitude of input must be 1 to 10 v rms.)

3-3 PLUG-IN CONTROLS

3-3-1 Input Channel Adjustments: The controls on both A and B input channels are identical. In addition to the following discussion, refer to paragraph 4.2 for a more detailed explanation of accuracy considerations.

3-3-2 AC-DC Switch: This switch permits the choice of AC or DC coupling of the input signal. In the DC position, the channel will produce output pulses when the instantaneous DC level of input voltage equals the selected trigger level voltage. In the AC position, the DC component of the input signal is removed and the channel is triggered when the instantaneous value of the AC component of input voltage is equal to the selected trigger voltage level. The specified input sensitivity of the instrument in the AC position is valid from 10 cps to 10 mcps.

3-3-3 Input Attenuator: The largest knob of the dual concentric control, selects an attenuation factor of 1, 3, 10, 30, or 100 for the input signal. It is advisable to select an attenuation factor that will reduce the input to within ±150 volts peak-to-peak; however, a signal of 500 volts peak-to-peak will not damage the instrument.

On the other hand, to minimize the effects of noise, it is desirable to select an attenuation factor that will reduce the noise component of input signal to less than 0.03 volts peak-to-peak.

3-3-4 Trigger Level Control: The smaller knob of the dual concentric control enables one to select any desired voltage level which will cause the A and B channels to trigger. The trigger voltage level is adjustable between approximately +3 volts and −3 volts with reference to the attenuated input signal. In terms of the unattenuated signal applied to the input jack, the trigger level is equal to the product of the selected attenuation factor and the trigger level voltage. (See "Channel Output")

In the RATE function, the A trigger control may be set at any level that will produce a consistent count indication.

For the most reliable triggering in the TIME or PERIOD function, select a trigger voltage level at approximately the center of the steepest slope of the input waveform if possible. This will reduce the possibility of spurious pulses from noise causing false counts.

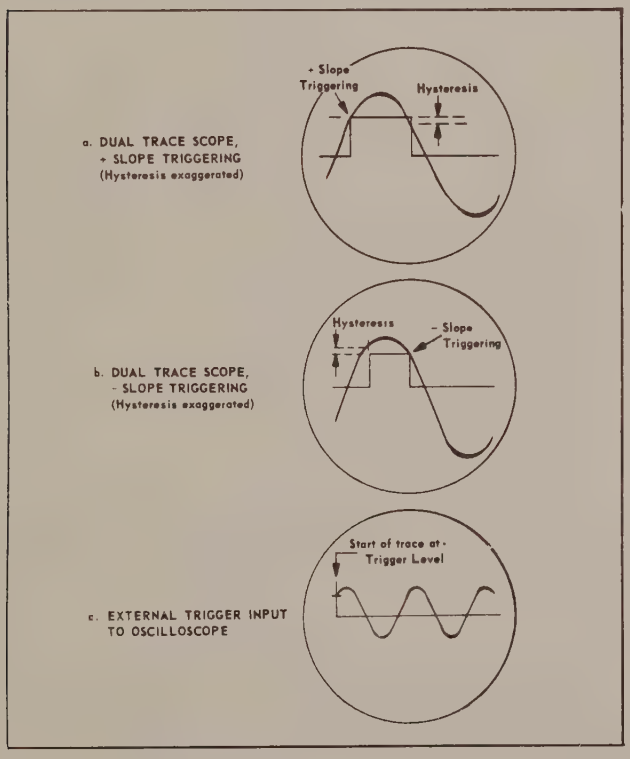

+ Slope Triggering
Hysteresis
a. DUAL TRACE SCOPE, + SLOPE TRIGGERING (Hysteresis exaggerated)
Hysteresis
- Slope Triggering
b. DUAL TRACE SCOPE, - SLOPE TRIGGERING (Hysteresis exaggerated)
Start of trace at Trigger Level
c. EXTERNAL TRIGGER INPUT TO OSCILLOSCOPE

Figure 3-2. Oscilloscope Display of Channel Output (Model 1926A)

3-3-5 Slope Controls: Both the A and B input channels have associated slope switches which are used in conjunction with the Trigger voltage controls. In the "+" position, the channel will produce a triggering pulse when the input signal rises to the selected trigger voltage level, and in the "−" position when the signal falls to the selected trigger voltage level.

In the PERIOD measurement only, (not PERIOD A x10) both slope switches are associated with the A channel and must be set to the same polarity in order to measure one complete cycle of the signal applied to this channel.

3-3-6 Channel Output: (Oscilloscope Trigger Marker Output) – The A and B channels have corresponding output jacks on the plug-in module panel which provide a rectangular waveform.

The positive-going portion of the rectangular waveform corresponds to the trigger point selected by the trigger level control. By superimposing this channel output waveform and the input signal waveform on a dual-trace oscilloscope, the precise trigger level of the input signal can be selected as indicated by the intersection of the two waveforms. (See Figure 3-2).

3-3-7 Separate-Combined Inputs: This switch is used in the COMBINED mode only for pulse width measurements with the TIME Interval mode. (Refer to TIME INTERVAL Measurements.)

3-4 SELF-CHECK OPERATION

3-4-1 The counter provides a self-check of its operation. In the TEST function, the internal 1.0 megacycle frequency is counted during each interval selected by the Time Base switch.

Steps:
1. Place the Function Selector in the TEST position.
2. Set the DISPLAY control for ease of reading.
3. Observe that the indication of the instrument in the various Time Base Selector positions corresponds to table 3-1.

Time Base Position	Frequency	Time	Correct Indication
10^{-6}	1 Mc	1.0 μs	0000010. Mc
10^{-5}	100 Kc	10 μs	000010.0 Mc
10^{-4}	10 Kc	100 μs	00010.00 Mc
10^{-3}	1 Kc	1 ms	0010.000 Mc
10^{-2}	100 cps	10 ms	010000.0 Kc
10^{-1}	10 cps	100 ms	10000.00 Kc
1	1 cps	1 sec (1)	0000.000 Kc
10	0.1 cps	10 sec (1)(0)	000.0000 Kc

±1 count tolerance in this column

Table 3-1 Self-check Indications

The count indication in the 1.0 μ sec position indicates the minimum time measurement which can be made with the counter. Note that all indications have a tolerance of ±1 count, which is the gating error of the counter. Although the count increases by a factor of 10 with each successive Time Base position, the decimal point is automatically shifted so that the count is given in frequency units (or time) as indicated on the annunciator. On longer time base intervals, the count exceeds the the capacity of the indicating decades and the indication

of the far left digit must be monitored to see if the correct number of cycles is completed. To confirm the unindicated first digit, repeat the measurement using the next shorter time base. The digit will now appear on the left indicator.

3-4-2 Amplifier Check:

The operation of the amplifier in the A channel may be checked as follows:

1. Place the Function selector in the COUNT position.
2. Press the RESET button.
3. With no input connected, and slope at "+", rotate the Trigger Level control through zero in the negative direction. One count should be registered in the decades.
4. Rotate the control back through zero in the positive direction. No count should be registered.

3-4-3 To Check the B Amplifier:

1. Place the Function switch in the TIME B-A position.
2. Place the Time Base selector in the 10^{-6}sec position.
3. Set both SLOPE switches "+" and both Trigger Level controls to "+".
4. Press the RESET button.
5. With no inputs connected, rotate the Trigger Level control of the A amplifier through zero in the negative direction. The decades should start counting the selected time base output frequency.
6. Rotate the Trigger Level control on the B amplifier through zero in the negative direction. The decades should stop counting and the count indication should remain until the end of the display period.
7. This check may be repeated with the controls referred to in step 3 initially in the "–" position and the rotation of the Trigger Level control reversed.

3-4-4 To Check Decimal Counting Units:

1. Place the Function switch in the COUNT position.
2. Place the Time Base selector in the "1" position.
3. Connect a coaxial cable from the T.B. out jack to the A input jack.
4. Rotate "A" trigger level until DC U's begin to count.
5. Press the RESET button.
6. The first indicator on the right should count 0 through 9 sequentially.
7. Place the Time Base selector in the 10^{-1} position.
8. Observe that the indicators count ten times faster and that the second indicator counts 0 through 9 sequentially.
9. Place the Time Base selector in the 10^{-2}, then 10^{-3} ...positions until all indicators have been observed.

3-5 HOW TO MAKE MEASUREMENTS

While making the individual measurements described below, refer as often as necessary to the foregoing discussion on "Use of Controls" and to "Accuracy of Measurements." In addition, typical applications for each type of measurements are discussed in Section 1.5, which may be helpful in suggesting how to set up a particular measurement. The illustrations in Section 4-1 may assist the operator to visualize the set-up for a measurement.

3-5-1 RATE (Frequency) Measurement:

The Rate function of the Counter-Timer may be used to measure the number of random events which occur in a unit of time or to measure directly the frequency of a regularly recurring signal. At lower frequencies, more accurate measurements of the signal are made by indirect measurement using the Period function.

1. Place the Function selector in the RATE position.
2. Place the A attenuator in the appropriate position.
3. Set the Time Base selector to a suitable time base frequency. The count indication will be cycles, kilocycles, or megacycles-per-second, according to the position of the Time Base selector.
4. Apply the input signal to the A amplifier and adjust the Trigger Level control until a stable indication is registered.

NOTE:

If a stable indication can not be obtained, try different attenuator positions and readjusting the Trigger Level control. Unless the input frequency is extremely stable, some instability of indication will be present.

3-5-2 Ratio Measurement (Using Rate Function)

Ratio measurements may be made in the rate function by using the rear panel BNC connector as a second input. When used in this manner the indication equals Ratio A/rear input. The input to the rear panel must be a signal between the limits of 10 Kc – 2 Mc, 1 to 10v rms. For a direct ratio the TIME BASE switch must be in the 10^{-6} position. Moving the time base switch to the 10^{-5} position yields a Ratio x10 indication, 10^{-4} equals Ratio x100 10^{-3} . . . :

1. Follow the instruction for the rate measurement.
2. Place the TIME BASE switch in the 10^{-6} position.
3. Place the INT-EXT switch in EXT.
4. Apply the second signal to the rear panel BNC.
5. Read indication (annunciator and decimal indications are invalid).

Another application of this feature is that the rear panel input may be used when an extended measurement is to be made. The 10 sec time base may be extended to 100 sec by applying a 100 Kc signal or to 1000 sec with a 10 Kc signal.

CAUTION:

The external signal for extending the Time Base must be extremely stable if a high degree of accuracy is desired.

3-5-3 Period Measurement:

The Period function is used to measure accurately the frequency of low repetition signals or to measure pulse width of the input signal. (Refer to "Accuracy of Measurements.")

1. Place the Function selector to the PERIOD A position.
2. Apply the input signal to the "A" input channel.
3. For period measurements, both SLOPE switches must be set to the same polarity.

4. For pulse width measurements, set the "A" channel SLOPE switch to the voltage change of the leading edge of the pulse ("+" if rising; "–" if falling) and set the "B" input SLOPE switch to the opposite polarity. Adjust the trigger level to the amplitude at which the pulse width measurement is desired.
5. Set the Time Base selector to a suitable frequency for the measurement being made. The indication will be in terms of seconds, milliseconds, or microseconds, depending on the time base selected. To convert the period measurement to frequency, take the reciprocal of the indication.

3-5-4 Period x10 and Period x100 Measurements:

Use of these functions increase the accuracy of a period measurement by counting ten or one hundred cycles of the input signal instead of one cycle.

1. Follow the procedure for the PERIOD measurement except disregard the "B" Slope switch.

NOTE:

Pulse width measurements cannot be made in the PERIOD x10 mode.

2. The period of the input signal being measured $= \frac{\text{count indication}}{10}$

The frequency of the input signal $= \frac{10}{\text{count indication}}$

3-5-5 TIME Interval Measurement:

The Time B–A function of the counter employs two input channels to measure the time between two events which occur on separate lines or are produced by separate sources. Two input signals of different amplitudes and DC levels may be applied. If the same input signal is applied to both channels, the time between two voltage levels on the waveform may be measured by appropriate settings of the Trigger level controls.

To make a Time Interval Measurement:

1. Place the Function selector in the TIME position.
2. Apply the input which is to start the time interval to the input of the "A" amplifier. Set the SLOPE switch above the amplifier to the polarity of voltage change which is to initiate the timing.
3. Apply the input signal which is to stop the time interval to the "B" amplifier. Set the SLOPE switch above the amplifier to the polarity of voltage change which is to stop the timing. If the same input is used for both start and stop signals, apply this signal to the "A" input and place the SEParate-COMbined switch at "COM."
4. Set the Time Base selector to a suitable frequency for the measurement being made. The indication will be in terms of seconds, milliseconds, or microseconds between the two signals.

3-5-6 Pulse Width Measurements in TIME B-A

Pulse width measurements are most conveniently made in the Period function, as described above, since only one trigger level control need be adjusted. However, for the measurement of pulse width of special waveforms, it may be advantageous to use the Time Interval function. Since a single input is applied to both A and B channels, the SEParate-COMbined input may be placed in the COMbined position for this type of measurement.

3-5-7 Counting

This function may be used to count the number of events which occur during a manually controlled length of time.

To count Events:

1. Place the Function selector in the HOLD position.
2. Apply the input to be counted to the A Amplifier.
3. Press RESET button.
4. Switch the Function selector to the COUNT position at the beginning of the time during which the events are to be counted.
5. Return the Function selector to the HOLD position at the end of the counting period.

Events may also be totalized during a remotely controlled period of time by use of the Gate or Ratio functions described below.

3-5-8 Frequency Ratio Measurement (A/B)

The Ratio function measures the ratio of two frequencies. It can also be used to measure the number of events occuring on one input channel during the period of a second signal. This function is analogous to the Period function except that the signal counted by the decades is provided from an external source in Ratio rather than from the time base as in Period.

To make a Ratio measurement.

1. Place the Function selector in the RATIO position.
2. Apply the higher frequency input to the A amplifier and apply the lower frequency signal to the B amplifier.
3. If the ratio of two regularly recurring signals is being measured, set both SLOPE switches to the same polarity.
4. The indication $= \frac{\text{freq. of A input}}{\text{freq. of B input}}$ (no decimal indication)

3-5-9 RATIO x10 Measurement (A/B x10)

This function permits increased accuracy in frequency ratio measurements. Follow the preceding procedure for Ratio Measurements.

The frequency ratio $= \frac{A \times 10}{B}$

3-5-10 GATE Function

The Gate function is analogous to Time Interval, with the exception that instead of the Time Base frequency being counted during the interval between the start and stop signals, the number of events of an external signal applied to the GATE channel occurring during the interval are counted.

To make a measurement in the GATE function:

1. Place the Function selector in the GATE position.
2. Apply the highest frequency signal (the events to be counted of the external time reference) to the GATE amplifier.
3. Apply the signal which is to start the measurement to the A amplifier.
4. Apply the signal which is to stop the measurement period to the B amplifier. Set the SLOPE switches to correspond to the polarity of each voltage change which is to produce the start and stop signals ("+" if rising voltage, "–" if falling).

Function	Start Signal	Stop Signal	Counted Signal
Test	Time Base	Time Base	10 Mc (Generated internally)
Rate	Time Base	Time Base	A Input
Count	Manual	Manual	A Input
Hold	N/A	N/A	N/A
Time B-A	A Input	B Input	Time Base
Period A	A Input (A)	A Input (A^1)	Time Base
Per A x10	A Input (A)	x10 Output (of A Input)	Time Base
Per A x100	A Input (A)	x100 Output (of A Input)	Time Base
Ratio A/B	B Input	B Input	A Input
Ratio A/B x10	B Input	x10 Output (of B Input)	A Input
Gate / B-A	A Input	B Input	Gate Input

Table 3-2 Signal Logic in the Operating Modes

Chapter 4 — PRINCIPLES OF OPERATION

4-1 PRINCIPLES OF MEASUREMENTS

The main function switch of the counter selects six basic modes of measurements which are explained as follows:

4-1-1 Rate (Frequency): The instrument counts the number of complete cycles of an input signal which occur during each unit of time selected by the Time Base switch. With reference to Figure 4-1, when a signal is applied to the C input channel, corresponding pulses are produced which pass through the gating circuit and are counted by the decade counting units which control the bi-quinary readout indicators. The counting interval is determined by start and stop pulses to the gate control circuitry which are supplied by two successive pulses from the Time Base Generator. The unit of time for the measurement is equal to the period of the selected time base frequency.

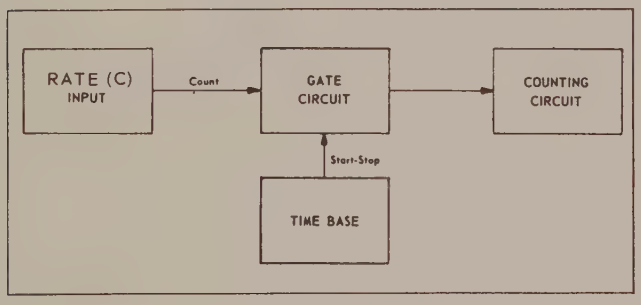


Figure 4-1 Rate (Frequency) Measurement

4-1-2 Count: The instrument counts the number of cycles of an input signal during an arbitrary period of time while the function selector is in the COUNT position. The HOLD position terminates the counting period. Refer to Figure 4-2. In this function, the input is manually controlled. There is no decimal indication.

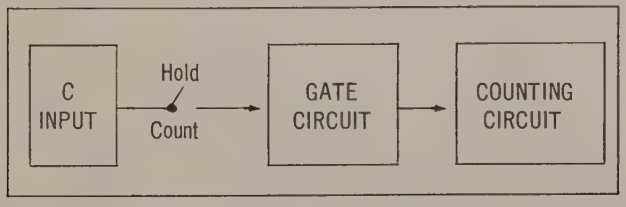


Figure 4-2 Counting Function

4-1-3 Time Interval:- The instrument counts the units of time selected by the Time Base switch which occur during the interval between two separate input signals. These signals may be applied from a single or two separate sources by means of the Separate-Combined switch. (Refer to Figure 4-3.

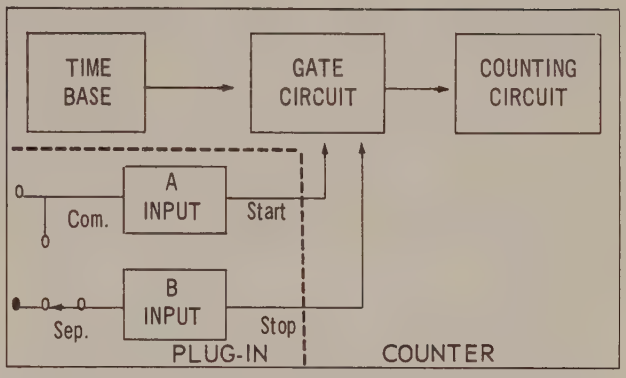


Figure 4-3 Time Interval Measurement

4-1-4 Period: The instrument counts the units of time selected by the time base switch which occur during each cycle of input signal. Figure 4-4 shows the circuit arrangement.

Pulses from the time base generator representing units of time pass through the gate during the interval determined by start and stop pulses which correspond to the beginning and end of one complete cycle of the input signal applied to the C channel.

In the x10 position, a frequency divider decade is inserted at the output of the C channel where it generates a pulse at every tenth cycle of input signal applied to this channel.

The x100 position utilizes the x10 output and again divides by a factor of 10, thus generating one output for every 100 cycles of input frequency.

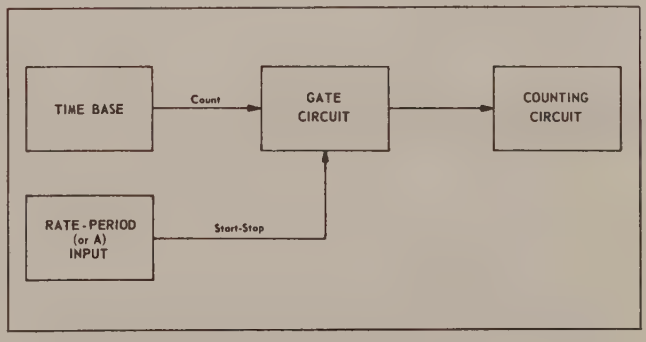


Figure 4-4 Period Measurement

4-1-5 Ratio: The instrument counts the number of complete cycles of the C input which occur during each cycle of the A input. There is no decimal indication. In the x10 position, the measurement is extended for a duration of ten cycles of the A input for greater accuracy of measurement. As shown by Figure 4-5, the circuit arrangement is similar to the RATE measurement except that the start and stop pulses to the gating circuit are provided from an external signal source applied to the A channel instead of from the Time Base generator.

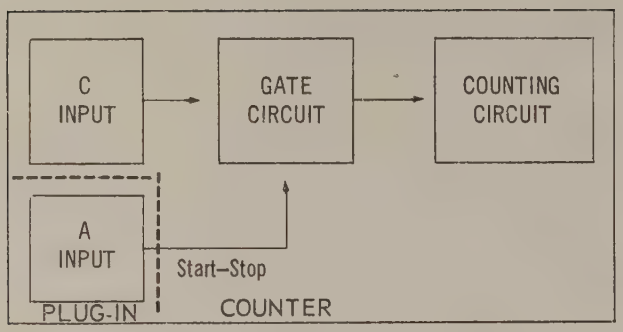


Figure 4-5 Ratio Measurement

4-1-6 Gate: The instrument counts the number of complete cycles of an input which occur during the interval between two other signals from separate sources. In this case (Figure 4-6, the start and stop pulses for the gating circuit are derived from the A and B input channels.

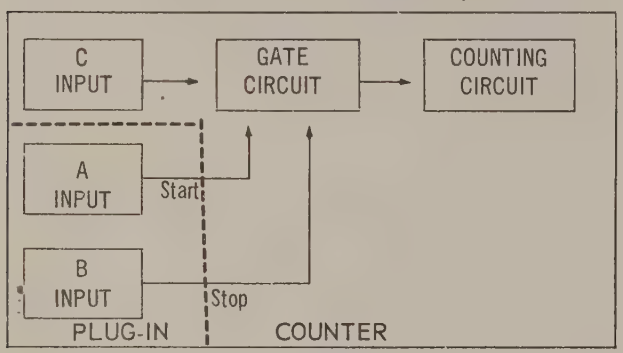


Figure 4-6 Gate Function

4-2 ACCURACY OF MEASUREMENTS

Measurements made with the counter are subject to the following sources of error:

1. Gating Error: Count missed or added as the gate opens and closes.
2. Time Generator Drift: Error caused by drift of the crystal oscillator.
3. Noise Error: Errors in the time a trigger pulse is produced due to noise on the input signal.
4. Loading Error: Error caused by loading of the input signal.

4-2-1 Gating Error:

Any measurement made by counting the number of events during a discrete interval may vary ±1 count. This variation is caused by events which occur simultaneously with the opening or closing of the gate. Since the gating error is a fixed amount of ±1 count, measurements set up to yield the highest count indication will be the most accurate as shown in the following equation:

$$\text{Max. \% Error} = \frac{100}{\text{count indicated}}$$

For example, if a 10 Kc signal is measured over a 0.1 second time base, the count indicated would be 1000 ±1 and the percentage of error would be ±0.1%. Measured over a 1 second time base, the count indicated would be 10000 ±1 and the percentage of error would be reduced to ±0.01%.

Higher frequencies yield the highest count indication when measurements are made using the RATE function and a long time base interval. Low frequencies yield the highest count when measured with the PERIOD function and a short time base interval. Figure 4-8 shows the comparative accuracies between the two functions and should be used as a guide in deciding which function to use.

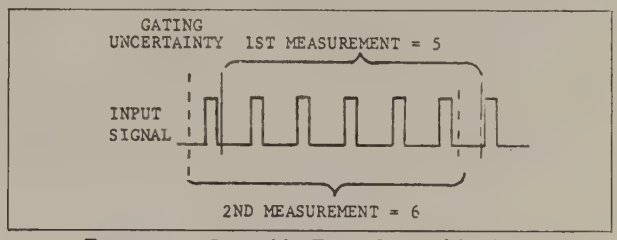


Figure 4-7 Possible Error Caused by Gating

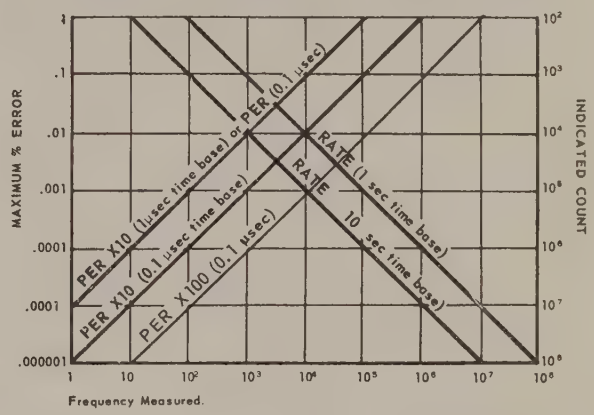


Figure 4-8 Accuracy of Period vs. Rate Measurements

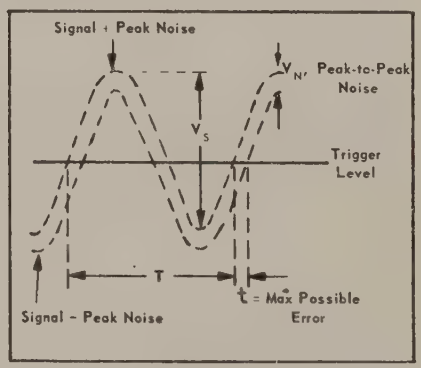


Figure 4-9 How Noise Produces Triggering Error

4-2-2 Time Generator Drift:

All measurements requiring a signal from the Time Generator are subjected to an error produced by variations in the reference oscillator frequency. The rated stability of the crystal oscillator is ±3 parts in 10^7 per week. Thus, the maximum error caused by oscillator drift is ±0.00003%. With Option B, the oscillator drift is reduced to ±3 parts in 10^9, or ±0.0000003% per day.

4-2-3 Noise Error:

Measurements using external start and stop trigger signals may be subjected to an error caused by extraneous noise on the attenuated input signal. The total signal may be considered as an ideal noise-free signal with a superimposed noise signal. The noise, added to the ideal signal, may trigger the channel before or after the selected instant for triggering. The maximum error in time for a given peak-to-peak noise voltage (V_n) and the slope (S) of the ideal signal at the trigger level is:

$$t\ (\text{sec}) = \frac{Vn\ (\text{volts})}{S\ (\text{volts/sec})}$$

Figure 4-10 shows an input sine wave signal with a superimposed noise signal.

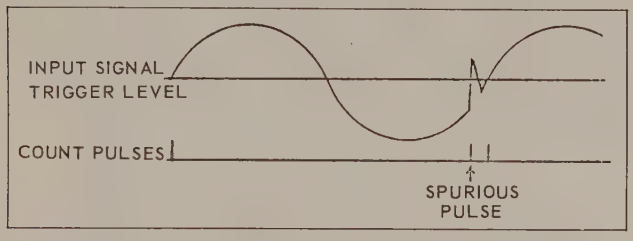


Figure 4-10 Spurious Counts From Noise Superimposed on Input Signal

The maximum percent error is:

$$\text{Max. \% error} = \frac{t\ (\text{sec}) \times 100}{T\ (\text{sec})}$$

For a sine wave triggering at its zero cross-over point:

$$\text{Max. \% error} = \frac{Vn\ (\text{volts}) \times 100}{\pi \cdot 5\ (\text{volts})}$$

From the foregoing discussion, it can be seen that as the amplitude of signal voltage is increased, the percentage of error is diminished. In addition, if the trigger level is set at the center of the steepest slope of the waveform, the maximum error will be reduced.

4-2-4 Loading Error:

Connection of the instrument to the external signal source may cause an amplitude or frequency shift of the external signal. This error will only be noticed on high impedance or high frequency type signal sources because of the high input impedance of the instrument. For signals of sufficient amplitude, the loading error can be reduced by placing either a small coupling capacitor or a large resistor in series with the input signal. The isolating component should be located at the signal source so that it will also isolate the cable capacity.

4-2-5 Total Error:

The various errors add up in the following manner to form the total error for each of the functions:

Function	Errors Present
RATE	Gating + Drift + Loading
PERIOD & TIME	Gating + Drift + Noise + Loading
RATIO & GATE	Gating + Noise + Loading

Table 4-1 Error Tabulation

4-3 OVERALL FUNCTIONS

This section contains circuit description and servicing data for the counter with the Universal Plug-in Amplifier. Information on optional features is given in separate supplements.

Refer to the master block diagram. The Count-Gate circuit is the focal point of the circuit functions. This circuit has two primary inputs: The "count" input, a signal which passes through the gate to drive the indicator tubes; and the "gate" input, which is a start and stop control signal from the control binaries circuitry, in the Display and Reset circuit block, and which turns the "count" input on and off. The ultimate sources of the "count," "start," and "stop" signals are the signals applied to the input amplifiers and the time base frequencies, as determined by the logic selected by the function switch.

4-3-1 GENERAL TROUBLE SYMPTOM GUIDE

The following trouble symptom guide will assist in locating quickly a malfunctioning circuit. Detailed servicing information for the individual circuits, including waveforms and trouble-shooting hints, is given in the referenced circuit descriptions. DC voltage levels are shown on the schematic diagrams.

The focal point in the counter is located on the 10 Mc Decade. It is the point where the control gate and the signal to be counted meet. Observation of this point with an oscilloscope is the best method of determining which direction to take while troubleshooting. The location of the focal point and a typical signal are shown in the drawing below.

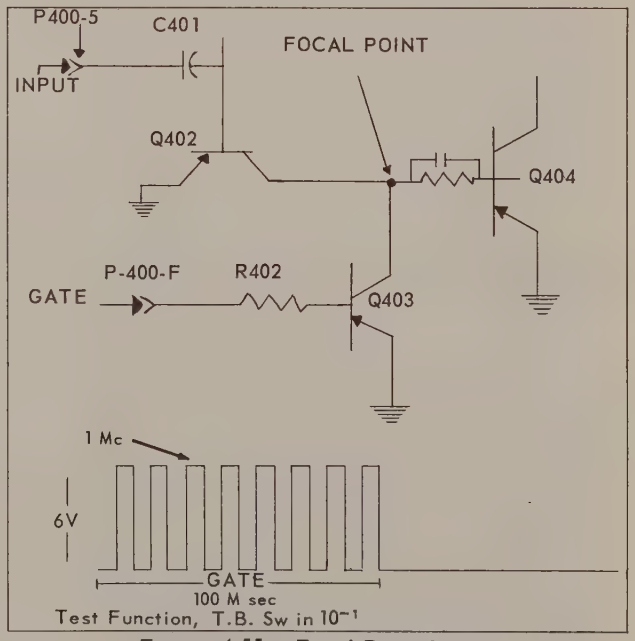


Figure 4-11 Focal Point Location

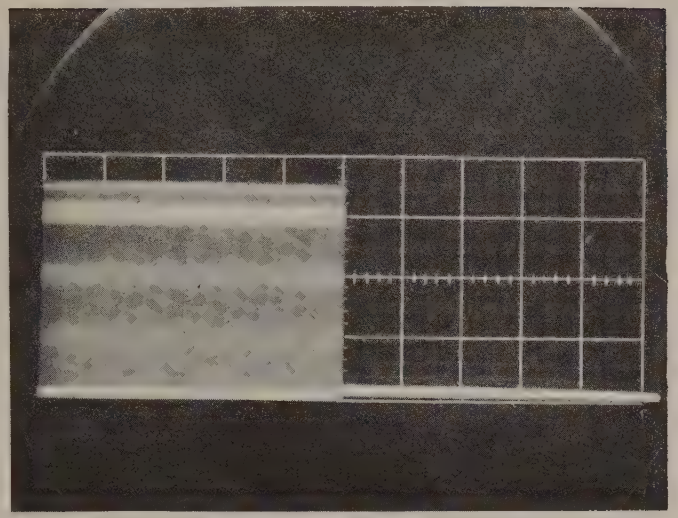
By observing the focal point when the counter is not operating properly, the defective signal path can be determined rapidly. From this start the circuits may be further isolated with the one of the following charts.

FUNCTION	FOCAL POINT	CHECK	RESULT	SECOND CHECK OR PROBLEM LOCATION
TEST	10 Mc Missing	J800-1 for 10 Mc signal	Present	Problem is S2-G or Wiring, Q402 on 10Mc
			Missing	Check Multiplier & Oscillator (10555)
	Gate Missing (No signal at all on Focal Point	J300-H (Start) J300-K (Stop)	Present	Check Display and Reset (14881)
			Missing	Check J800-A, if OK Check J200-7, H
RATE	A Input Missing	J1-36	Present	Problem is in S2-G or Wiring
			Missing	Problem is in Plug-in
	Gate Missing	Same as Test		
COUNT	A Input Missing	Same as Rate		
	Gate Missing	J401-F for +6v (approx.)	Present	10 Mc Decade bad (Q403)
			Missing	Check J300-H for 10 Mc signal if present Display and Reset is bad.
HOLD	No signal should be present	Check J300-9 for Ground	Present	Problem is on Display and Reset
			Missing	Problem is S2-A or Wiring
TIME B-A	Time Base Missing	J800-A for T. B. Signal	Present	Problem is S2G, wiring, or Q402 on 10 Mc Decade
			Missing	Check J200-7, H if OK check J800-H if OK Oscillator and Multiplier is bad
	Gate Missing	J300-H for A Input Signal	Present	Bad Display and Reset, Wiring or Q403 on 10 Mc Decade
			Missing	Check J1-36 if signal is missing Plug-in is bad, if signal is present S2-F or wiring is bad
	Gate Present, but does not stop	J300-K	Present	Bad Display and Reset or wiring
			Missing	Check J1-30, if signal is missing. Plug-in is bad, if present S2-E or wiring is bad.
PER A	Time Base Missing	Same as Time B-A		
	Gate Missing	J300-H for "A" Input Signal		Same as Time B-A
	Gate present but does not stop	J300-K for "A^1" signal	Present	Bad Display and Reset
			Missing	Check J1-39 if Signal is present, wiring or S2-E is bad, if not present Plug-in is bad.
PER x10 PER x100	Time Base Missing	Same as Time B-A		
	Gate Missing	Same as Per "A"		
	Gate Present, but does not stop	J300-K for "A" signal ÷ 10 or 100	Present	Bad Display and Reset
			Missing	x10 Check J300-1 x100 Check J300-B if Missing x10 Check J300-A for "A" signal x100 Check J300-2 for A x10 signal If missing S2-C (x10), S2-D (x100) or wiring is bad, if present Display and Reset is bad
RATIO A/B	A Signal Missing	Same as Rate		
	Gate Missing	J1-30 for "B" signal	Present	S2-E, S2-F, or wiring bad
			Missing	Plug-in is bad
RATIO A/B x10	A Signal Missing	Same as Rate		
	Gate Missing	Same as Ratio A/B		
	Gate Present but does not stop	J300-K for B Signal x10	Present	Bad Display and Reset or wiring
			Missing	Check J300-1 if OK S2-E or wiring is bad, if bad check S300-A if OK Display and Reset is bad, if bad S2-C, wiring or Plug-in is bad
$GATE/_{B-A}$	Gate Signal Missing	J400-5 for presence of Gate Signal	Present	Q402 on 10 Mc Decade or wiring bad
			Missing	Check J1-33 if Gate Signal is present S2-G or wiring is bad, if missing Plug-in is bad.

The checks outlined in the chart assume that the Power Supply voltages are present and correct and that the inputs are present and of sufficient amplitude. The checks should be used in conjunction with the Block diagram of the Model 1034, These checks are not comprehensive but are intended as general guides to enable the maintenance man to isolate a problem into a general area of the counter.

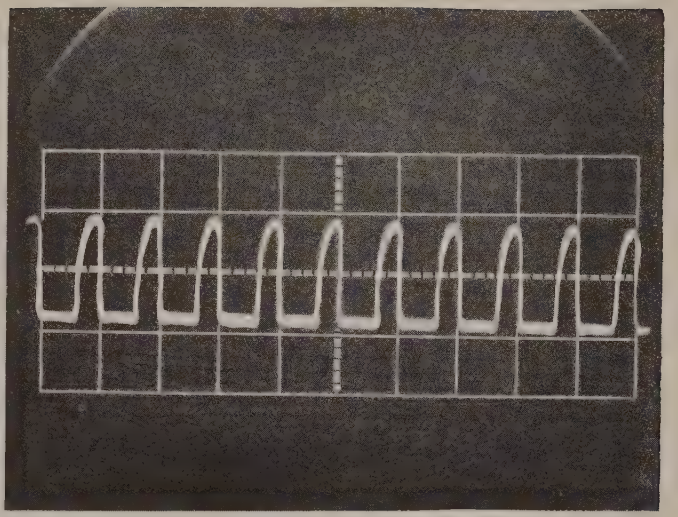
The pictures of waveforms that accompany the troubleshooting check serve to illustrate how the various signals appear during normal operation. All pictures were taken using a Textronic Model 581 Oscilloscope and an x10 attenuator probe. V/cm readings take the attenuation factor into account.

Gate and Input at Focal Point



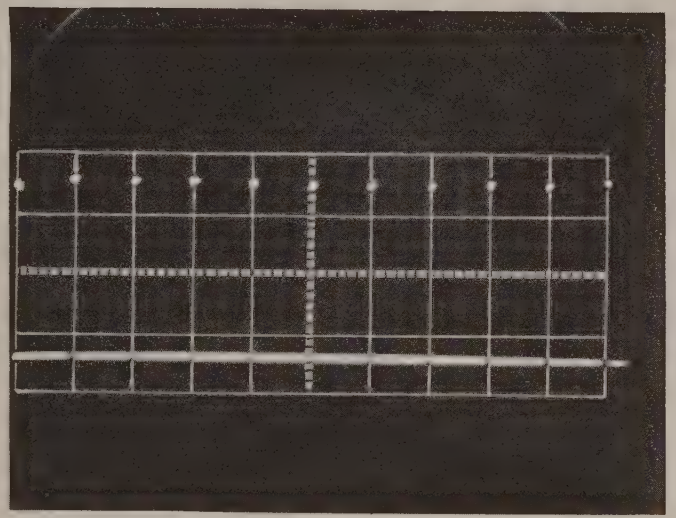
Test - T. B. in 10^{-2}

A Input Signal



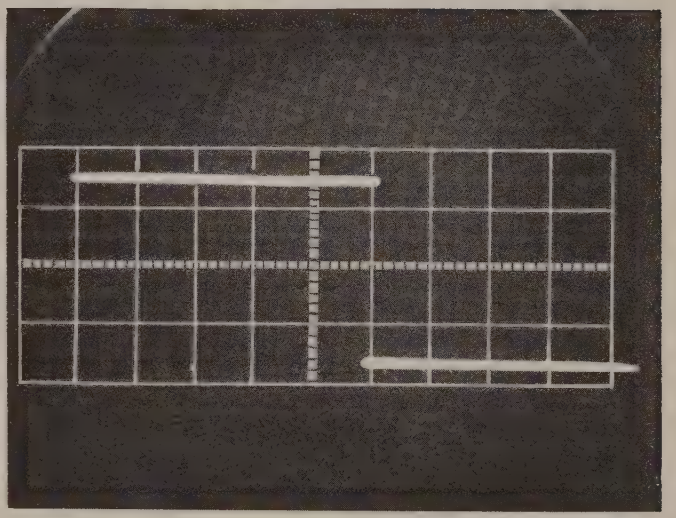
Rate – Input = 100 Kc

Time Base at 5-300-H



T. B. Set to 10^{-5}

Gate Signal at J301-F



Time Base at 10^{-2}

4-3-2 POWER SUPPLY

Circuit Description:

The power supply furnishes the following output voltages:

Voltage	Current	Use
+30v	500 ma	Transistor biasing
-30v	500 ma	Transistor biasing
+ 6v	500 ma	Transistor biasing
- 6v	500 ma	Transistor biasing
+225v	50 ma	Indicator tube B+
+43v	5 ma	Indicator tube biasing
+20v	10 ma	Heterodyne unit
-15v	50 ma	Heterodyne unit

Table 4-3 Power Supply Voltage

The +30v, -30v, +6v, and -6v outputs are obtained from individual voltage sections. Using the -30v section as an illustration, a full-wave diode rectifier (CR11 and CR12) generates an unregulated 40 volts which is applied to an "L" filter consisting of R5 and C5. The filtered DC passes through a series regulator (Q5), transistor, to the output terminal. The regulator is controlled by degenerative feedback from the regulating amplifier, Q106 and Q107, and acts as a variable impedance device which compensates for changes in output voltage level. At a stable condition, the voltage at the arm of R131 in the output divider network is virtually zero with respect to the fixed bias level at the emitter of Q106 created by Zener diode CR105, which is the prime reference for the supply. When the output level drifts, an error voltage at the arm of R131 is sensed by the regulating amplifier. The degenerative loop action of the amplifier tends to reduce the error voltage to zero again. The output voltage level can be varied by changing the setting of R131. Output regulation is maintained to within 2%.

The +30v power supply is identical except that the circuit is grounded at the low side, which shifts the high side to a +30v level.

In the +6v and -6v supplies, Q3 and Q4 are the series regulators and Q104 and Q105 are the corresponding amplifiers. Regulation is dependent, not upon +6v and -6v outputs but upon the +30v and -30v outputs applied to the amplifiers through R115 and R121, respectively. The fixed-bias reference for each of these amplifiers is provided by the voltage across Zener diodes CR103 and CR104.

The +225v output is generated by a bridge type rectifier circuit (CR1 through CR4) having a series regulator transistor, Q1 which is controlled by a single-stage amplifier, Q101. The -30v regulated output applied to R103 in the divider network is the prime reference for this circuit.

The +43v output is generated by a type IN716 13-volt Zener diode, CR101, connected across the +30v and 225v outputs.

4-3-3 BLANKING CIRCUIT:

The indicator tubes may, at the operator's wish, be blanked-out during the count cycle so that an indication is obtained only after the final count is registered. Blanking is accomplished when Q109 is turned off and a +15v is applied to the blanking line to each decade unit. This positive voltage turns on both transistors in the binary section of the biquinary drive circuit (Q400, Q401, Q500, Q501, etc.) which turn off the following switch transistors, removing B+ from the indicator tubes. The blanking gate consists of inputs through diode CR106 and resistors R133 and R134. When any of these inputs is connected to -6v or greater, transistor Q108 will turn off and transistor Q109 will turn on to prevent blanking. Thus, if the blanking switch is in the "off" position, or the Function switch is in the Count or Hold mode, no blanking will occur. With blanking on, the end-of-count signal input from the Display and Reset module will control blanking. At reset and during the count cycle, this input is 0 volts and blanking takes place, since Q108 is on. After the "stop" pulse, a -6v end-of-count signal level occurs which removes blanking.

4-3-4 STORAGE

The optional circuitry for the storage function produces an output waveform shown in Figure 4-16, which controls the Silicon-Controlled switch used in the storage decades provided with Option S. The negative end-of-count pulse is applied to one-shot circuit consisting of Q111 and Q112. The resulting waveform is applied, through Q414 emittor follower, as one input to an AND gate together with the normal quinary gating signals described in Section 4-3-12, "Bi-Quinary Drive Circuit." The negative portion of the waveform turns the SCS off and blanks the indicator. One millisecond later, when the following positive pulse is received, the SCS will turn on if the proper quinary gating signals are present. Once the SCS is turned on, its holding characteristics will keep it turned on, regardless of how the quinary gating signals may change. The indicator, therefore, will hold the count which has occurred at the end-of-count signal and will not indicate subsequent counts until the following end-of-count pulse turns it off and then on again.

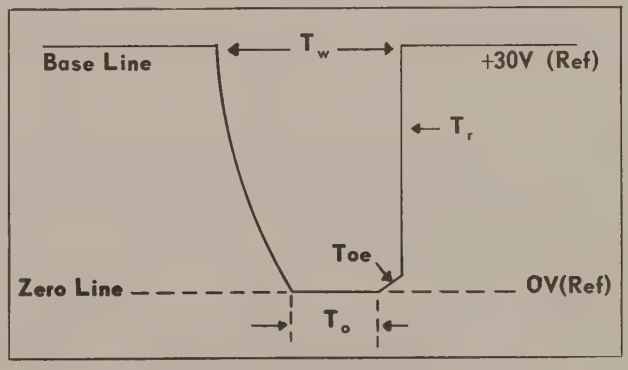


Figure 4-11 Storage Output Waveform

When the storage function is switched off by the Blanking/Storage switch or the Function selector in the "Count-Hold" function, a -30v signal is applied through CR108 or CR109 which releases the unijunction relaxation oscillator (Q113). This circuit is identical to the automatic reset oscillator in the Display and Reset circuitry except that it oscillates at approximately 100 cps. The pulse output triggers the storage one-shot at this rate, in place of the end-of-count signal, thereby effectively defeating the storage function.

4-3-5 POWER SUPPLY TROUBLE SYMPTOM GUIDE

(Component Schematic Reference numbers apply to -30v section only.)

Table 4-4 Power Supply Trouble Symptoms

SYMPTOM	CAUSE
Voltage not regulated, may oscillate slowly	Zener reference diode CR105, open.
Voltage varies with line voltage or load change	Loss of gain in regulator transistors, Q106 or Q102.
Excessive ripple, high output	Defective Zener diode, CR105. Filter capacitor open, C5.
Excessive ripple, low output	Diode rectifier, CR11 or CR12 open.
Output cannot be adjusted	Regulator transistor open Q106, Q107.
No output, one section	Fuse or series control transistor 2N2138 open. Transformer secondary winding open. (Check unregulated DC or AC).
No output, all sections	Transformer primary open.
Blanking Circuitry	
No illumination with blanking on (normal with blanking off)	Q108 leaky, Q109 open, CR106 open.
No blanking	Q108 open, Q109 shorted.

4-3-6 STANDARD OSCILLATOR

Oscillator Circuit Description:

The standard oscillator circuit (Dwg. 10555) generates a 1 megacycle sine wave which is applied to the Time Base circuits. This oscillator board also contains a 1 Mc shaper, which converts the 1 megacycle sine wave into a 1 megacycle square wave. This square wave synchronizes a multiplier circuit which has a 10 megacycle output. The board also contains an OR gate operated by the time base selector which selects either the Time Base output frequencies or the 10 megacycle output.

The oscillator is controlled by a 1 megacycle crystal housed in an oven. After initial adjustment and warm-up the oscillator frequency maintains a frequency stability of ± 3 parts in 10,000,000 per week.

The oscillator circuit is a feedback oscillator of the Meacham bridge type, characterized by very low phase shift necessary for frequency stability and undistorted sine wave output. Figure 10 shows a simplified schematic with the bridge circuitry emphasized.

Transistors Q801, Q802, and Q803 form an amplifier with a gain of approximately 1,000. Q803 is an RF power output type of transistor. The signal from the secondary of output transformer T802 is coupled back regeneratively to the bridge. C802 tunes this circuit to the fundamental frequency. A sine wave of approximately 2.8 volts nominal amplitude appears at the output terminal. Amplitude stability is maintained by the tungsten filament lamp, 1801, in the bridge circuit. The nonlinear characteristics of the lamp compensate for changes in power supply voltages and component aging. R801 is adjustable to compensate for variations in crystal impedance. It should be set to produce an undistorted output sinewave of sufficient amplitude. In practice the best means of adjusting the oscillator is to tune C802 for maximum amplitude of the 1 Mc output sine wave; R801 may then be adjusted until the desired 1v rms (2.8v peak-to-peak) output is achieved. The best means of adjusting the oscillator frequency is to utilize a 1 Mc standard to synchronize an oscilloscope, by applying the 1 Mc output to the vertical amplifier of the scope and adjusting the trimmer capacitor, located in the top of the crystal, for minimum drift on the scope. A close adjustment of frequency may be made in this manner.

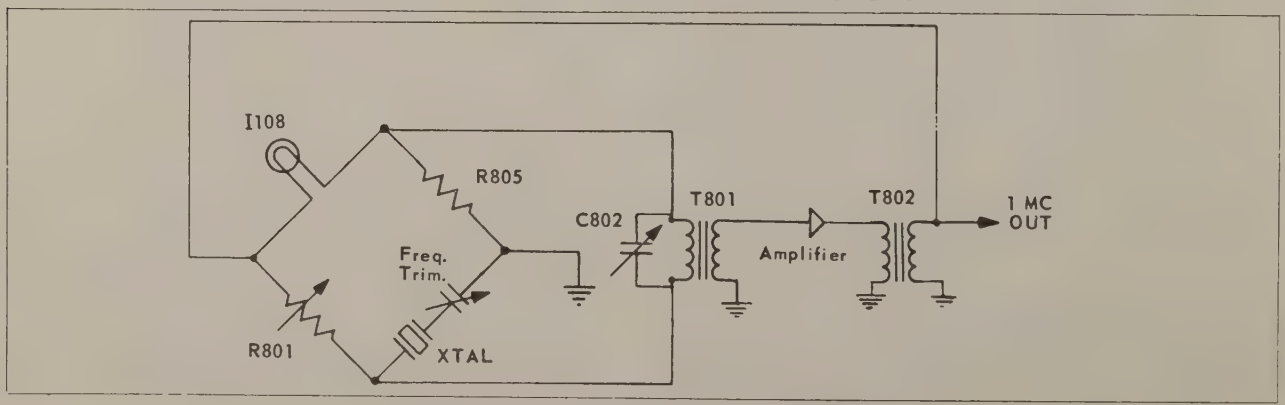


Figure 4-17 Simplified Oscillator Schematic

NOTE:

With the oscilloscope time base set at 0.1 μ sec a 1 cm/sec drift represents an error of 1 $x10^{7}$.

4-3-7 SERVICING GUIDE (1 Mc Oscillator)

If no 1 Mc sine wave is observed with an oscilloscope at the rear 1 Mc connector:

1. Check the components in the bridge circuit, especially the lamp 1801 and the potentiometer, R801.
2. Check the crystal by removing the oven and inserting a 47-ohm resistor between pins 4 and 7 of the oven socket.
3. Check the voltage levels as shown on the schematic.
4. Check the windings of T801 and T802.

If a distorted (clipped) sine wave appears, re-adjust R801 and also check the bridge and other components.

4-3-8 10 MCS MULTIPLIER CIRCUIT DESCRIPTION

NOTE:
The 10 Mcs Multiplier is not included in the Model 1033.

The 10 Mcs multiplier section consists of a x5 multiplier stage (Q804) followed by a x2 multiplier (Q805) and a tuned amplifier (Q807), Q804, together with a tuned tank circuit at the collector, forms a damped oscillator which is tuned by adjusting for a frequency of 5 Mcs at the base of Q805.

Q804, operating as a class C amplifier, is triggered into oscillation by the 1 Mc rectangular pulses from the shaper circuit of Q814. Two additional stages follow with the Q805 and Q807 circuits being tuned to 10 Mcs. One 10 Mcs output is used as the basic frequency for the heterodyne plug-in units (Option H). The other 10 Mcs output, which is used as the gate input signal during the Test function, is obtained from the output of Q808. The negative output pulse from this shaper stage is peak-limited at -6v by CR801.

The output of Q807 is also applied through another shaper stage (Q812) to Q811, which is one-half of a gate circuit. The Time Base output frequency is applied to the second side of this gate (Q810) through a shaper stage (Q809) similar to Q812. The 10 Mcs negative pulse is grounded out in all positions of the time base selector switch, except "10 MC" by means of the +6v bias applied to the base of Q811 through the switch transistor Q813. At the same time, the selected time base frequency passes through to the time base output terminal, J800-A. In the 10 MC position, a +30v is applied through the time base switch to the base of Q810 and Q813, cutting off both transistors. Consequently, the +6v bias is removed from Q811 which allows the 10 Mcs signal to pass.

4-3-9 10 MC MULTIPLIER SERVICE GUIDE

No operation during "Test" may indicate loss of 10 Mcs signal. If present at TIME BASE OUTPUT jack, then the Q808 shaper stage is faulty.

If there is no count indication in the TEST function due to no 10 Mcs output, check for presence of 1 Mcs input at P800, pin E, 5 Mcs at base of Q805, and 10 Mcs at base of Q806, Q807, and Q808.

If the 10 Mcs test signal is off by 20% or more, check the 10 Mcs multiplier alignment procedure. (See "Time Base Servicing Guide" also.)

4-3-10 TIME BASE CIRCUIT

(Refer to Dwg. 15423) The Time Base circuit contains five decade stages connected in series, each one of which divides the input frequency applied to it by a factor of ten. A 1 Mc output signal from the oscillator multiplier module is applied at pin P201-L to a Schmitt trigger shaper circuit, Q19-Q20. The output of Q20 is then applied directly to the 2 Mc decade (the first in the chain of five) and also through Q21 to the x10 stage in the Multiplier module. The chain of five decades generate the following time base frequencies.

Table 4-5 Time Base Frequencies

Decade	P200 Terminal	Output Frequency (Period)
1	4	100 KC (0.01 msec)
2	6	10 KC (0.1 msec)
3	B	1 KC (1 msec)
4	C	100 cps (0.01 sec)
5	5	10 cps (0.1 sec)

The remaining two time base frequencies (1 cps and 0.1 cps) are generated within the Display and Reset circuit module.

The basic decade or decimal counting unit consists of four binaries which operate in a chain to produce one output pulse for every ten input pulses. Each binary is triggered into one of two stable states by positive input pulses. In the "1" state, the left or odd-numbered transistor (relative to the schematic) conducts and the binary output level at the collector of the non-conducting transistor is -6 volts ("1" level) for PNP type decades. In the "0" state, the opposite condition exists and the output is +6 volts ("+" level). In the simplified diagram of Figure 11, the shaded areas indicate which transistors in the decade are conducting at the reset condition. The binary logic is 0-0-0-0, which is equivalent to a coded "0". (The x10 - x100 decades in the Display and Reset circuit reset to "9"; decades are not reset in the time base).

The first three binaries have dual mode triggering through the parallel input steering diode connections and therefore change from one state to another on receiving successive positive pulses from the preceding stage or decade input. In dual mode triggering, one steering diode is cut off by the -6 volts at the collector of the non-conducting transistor. The positive input pulse passes through the other steering diode and cuts off the conducting transistor. The following positive pulse will not pass through the same diode because of the reversal of biasing. Binary A alternates with every input pulse or "count", Binary B with every second count (when not inhibited), and Binary C with every fourth count. Binary D has two single-mode trigger inputs:

a. the positive output of Binary A, being coupled to the odd-numbered transistor, will cause it to trigger to the "0" state only;
b. similarly, the positive output of Binary C, being coupled to the even-numbered transistor, will cause it to trigger to the "1" state only.

A third special condition exists at the input to Binary B;

c. Feedback from the output of Binary D through R20 and the normal input through C9 form an AND gate.

A positive input will pass only if the output of Binary D is positive, which prevents the next positive pulse from passing from triggering at count "0". The complete sequence of events is shown in Figure 13. The arrows in the illustration indicate the triggering modes discussed above.

The time base output frequency selected by the Time Base switch (Section S1-G) is applied through terminal P200-8 to a shaper circuit (Q17, Q18). The shaper output is applied through terminal P200-7 to the time base selector circuit in the Multiplier circuit module.

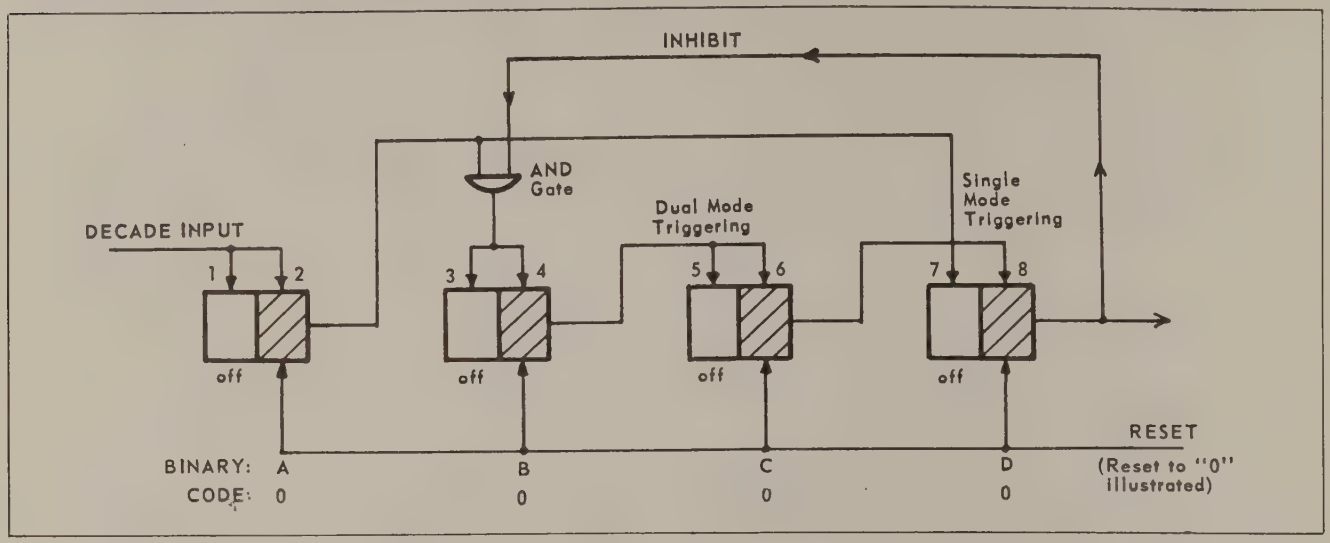


Figure 4-18 PNP Decade–Reset to "0"

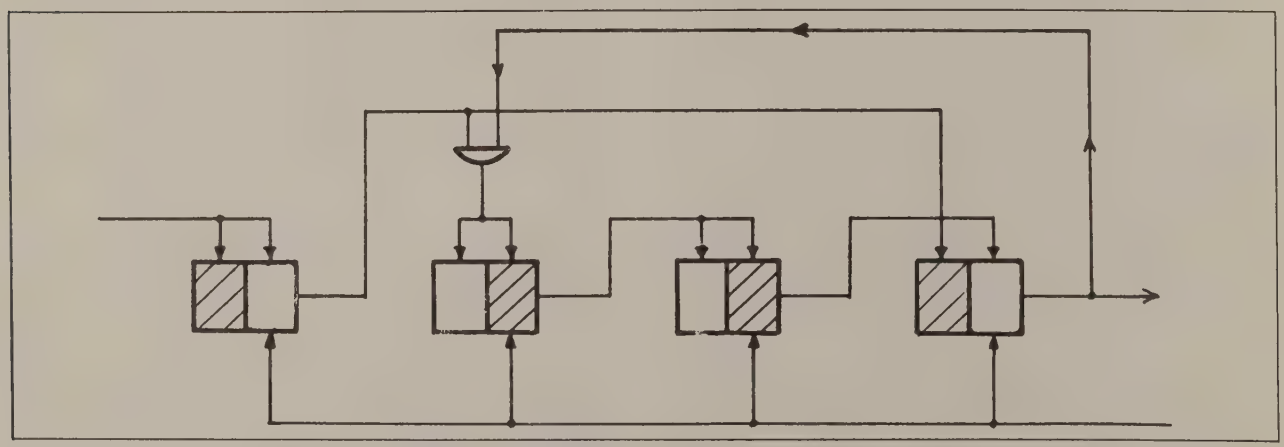


Figure 4-19 PNP Decade–Reset to "9"

4-3-11 DISPLAY AND RESET

Circuit Description (Refer to Dwg. No. 14881)

Control Binaries:

The output pulses from the input amplifiers and from the time base circuitry are applied to the start and stop inputs of the control binaries. These inputs respond only to positive-going input pulses by virtue of diodes CR8 and CR12.

Assuming that the control circuitry is in the "reset" condition (all indicator tubes register "0", a positive "start" pulse is applied through C10 which turns off Q3 and turns on Q4 in the binary circuit. A positive-going output at the collector of Q4 turns Q5 off and Q6 on in the following binary. Consequently, a high (zero volt) Gate level output occurs at terminal F which opens the gate and causes the decimal counting units to cycle, provided that there is a "count" input signal present. If a stop impulse were received prior to the "start" pulse, this would tend to turn off the already off Q4 and, therefore, nothing would happen.

When a positive "stop" pulse arrives, only binary Q5/Q6 flips, causing the Gate level output to change to

a −6 volt (gate closed) level, as limited by CR31. Because the collectors of both Q3 and Q6 are now at zero potential, a +10 volts potential is applied through R52, turning off Q14 (an NPN type transistor), and producing a −6v end-of-count signal at terminal K which is connected to the blanking-storage gate in the power supply. At the same time, Q10 is turned off and initiates the reset signal after a delay for display interval.

Reset Signal:

When Q10 is turned off by the "stop" pulse, capacitor C8 charges up towards +30 volts through the series network including R17 and the DISPLAY time control. When the voltage rises to the peak point of Q11 this unijunction transistor fires, discharging C8. The resultant pulse across R8 drives the following reset pulse circuitry. The output of Q12 resets the start-stop binaries.

The display time delay interval is determined by the rate of charge of C8 and can be adjusted by the Display control. When the display control switch is in the C8 "infinite" position, the charge path is opened and will never charge so that a manual reset pulse is required.

Similarly, no reset will occur if terminal B (P302) is externally grounded. By this means, an external printer or digital voltmeter can inhibit reset until its cycle of operation has been completed.

The ground potential which occurs at terminal C (P302) when Q7 turns on may be used as the print command signal to initiate the operating cycle of an external printer.

Inhibit Signal:

Note that the output of Q13 triggers a one shot (Q8/Q9) the output of which inhibits the start input through CR9 until the one-shot returns to its normal condition after approximately 20 milliseconds delay. This action assures that no start pulse will open the gate until all circuits in the counter are reset.

The PNP transistors in the decade units are reset by the output of Q35. Q13 inverts the signal to produce the NPN Reset output at the collector of Q36. Q16 reset output drives the two decades in the Reset and Display circuit. The reset signal is also applied to a second one-shot (Q33/Q34) which inhibits the input to the X10 decade until reset action is complete throughout the X10 and X100 Decades.

X10 and X100 Decades:

These two circuits are essentially identical to the typical decade units described in Section 4-3-12. Refer to that section of the manual for circuit details.

In all positions of the Function Selector except the X100 functions, the input to the X100 decade is the 10 cps time base signal. This circuit, therefore, produces the 1 cps time base at the output. In all functions except X10 and X100, the 1 cps output of the X100 decade is applied to the X10 decade which produces the 0.1cps time base outputs. Note that these decades are reset to "9" so that each will produce an output pulse when the first input pulse is received.

In the X10 or X100 positions, the input signal used for gating passes through one or both decades so that the gating interval is extended 10 or 100 times.

Servicing Guide:

When servicing the Display and Reset board, first confirm that start and stop pulses are available at the input terminals. If no Gate level signal at terminal F (P301) occurs with start and stop pulses applied, check transistors Q3 through Q6 and associated components.

If the X10 or X100 decade section is mal-functioning, refer to the "Decade" circuit description and trouble symptom guide.

4-3-12 DECIMAL COUNTING UNITS 10 Mc, 2.5 Mc, 250 Kc DECADES

Basic Decade Unit:

The following description is based upon the 2.5Mc decade, which uses PNP type transistors resulting in the voltage polarities given. The 250Kc decades use NPN transistors and therefore all polarities are reversed. The differences between these decades are described in subsequent paragraphs.

The basic decade or decimal counting unit consists of four binaries which operate in a chain to produce one output pulse for every ten input pulses. At the same time, ten discret states of collector voltage levels of the four binaries are obtained to produce a scale-of-ten or binary-coded decimal output.

Each binary is triggered into one of two stable states by positive input pulses. In the "1" state, the left or odd-numbered transistor (relative to the schematic) conducts and the binary output level at the collector of the non-conducting transistor is −6 volts ("−" level) for PNP type decades. In the "0" state, the opposite condition exists and the output is 0 volts ("+" level). In the simplified diagram (Figure 4-18), the shaded areas indicate which transistors in the decade are conducting at the reset condition. The binary logic is 0-0-0-0, which is equivalent to a coded "0". (The x10-x100 decades in the Display and Reset circuit reset to "9"; all others reset to "0").

The three binaries have dual mode triggering through the parallel input steering diode connections and therefore change from one state to another on receiving successive positive pulses from the preceding stage or decade input. In dual mode triggering, one steering diode is cut off by the −6 volts at the collector of the non-conducting transistor. The following positive pulse will not pass through the same diode because of the reversal of biasing. Binary A alternates with every input pulse or "count", Binary B with every second count (when not inhibited), and Binary C with every fourth count. Binary D has two single mode trigger inputs:

a. the positive output of Binary A being coupled to the odd-numbered transistor, will cause it to trigger to the "0" state only;

b. similarily, the positive output of Binary C being coupled to the even-numbered transistor, will cause it to trigger to the "1" state only. A third special condition exists at the input to Binary B.

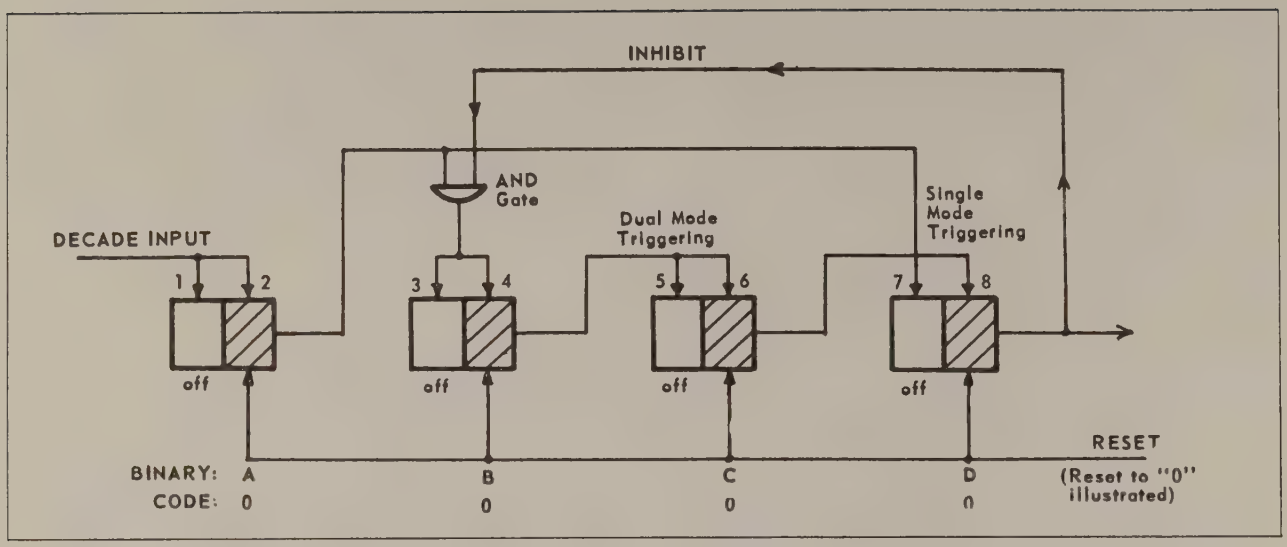


Figure 4-20 Simplified Diagram of NPN Decade Unit (250K)

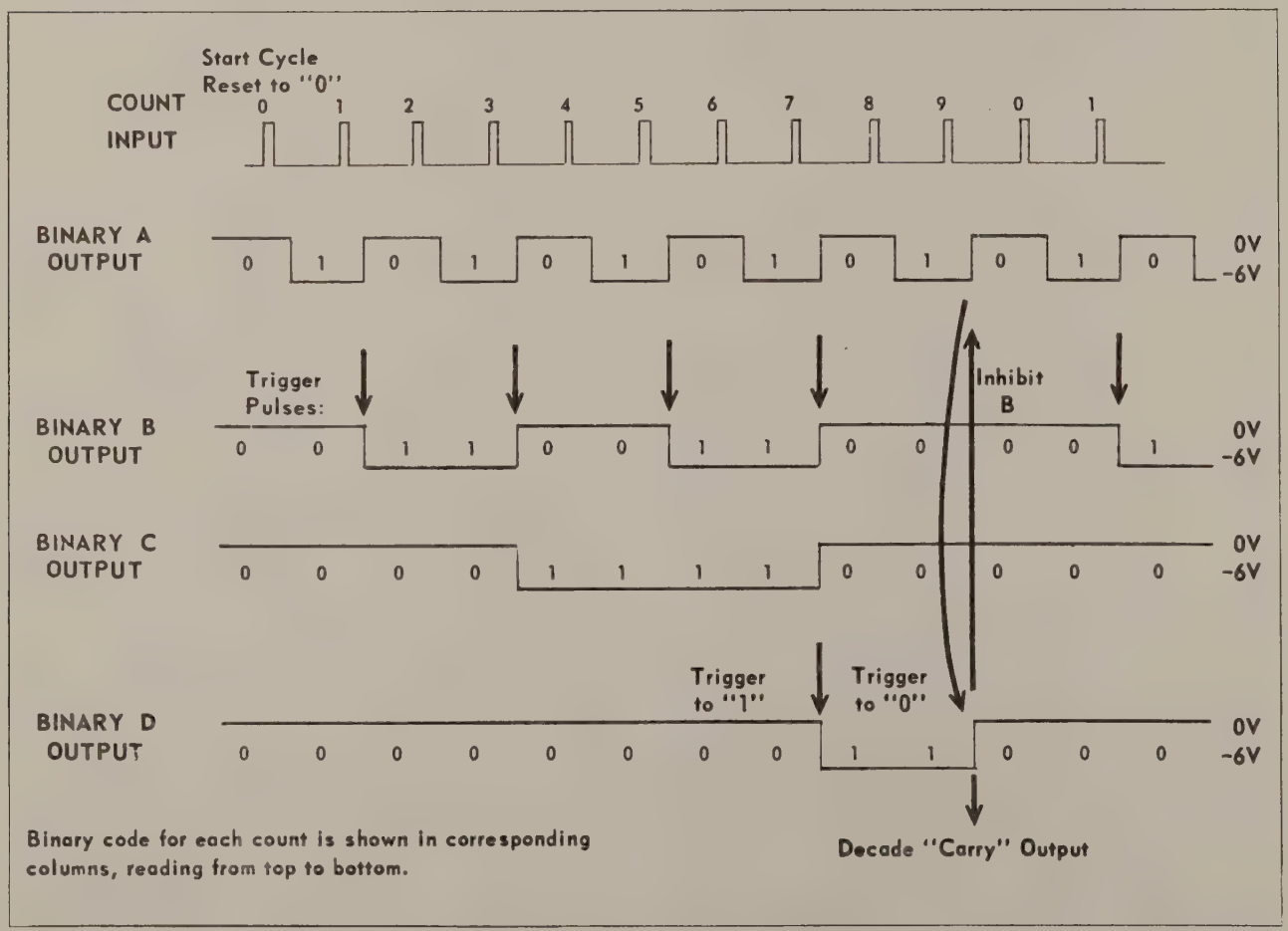

Start Cycle Reset to "0"
COUNT INPUT
0 1 2 3 4 5 6 7 8 9 0 1
BINARY A OUTPUT
0 1 0 1 0 1 0 1 0 1 0 1 0
0V
-6V
Trigger Pulses:
Inhibit B
BINARY B OUTPUT
0 0 1 1 0 0 1 1 0 0 0 0 1
BINARY C OUTPUT
0 0 0 0 1 1 1 1 0 0 0 0 0
Trigger to "1"
Trigger to "0"
BINARY D OUTPUT
0 0 0 0 0 0 0 0 1 1 0 0 0
Binary code for each count is shown in corresponding columns, reading from top to bottom.
Decade "Carry" Output

Figure 4-21 Timing Sequency Diagram (for PNP type Decade)

Feedback from the output of Binary D through R510 and the normal input through C504 form an AND gate. A positive input will pass only if the output of Binary D is positive. On counts 8 and 9, the output is negative, which prevents the next positive pulse from passing through the gate. Therefore, Binary B is inhibited from triggering at count "0". The complete sequence of events is shown in Figure 13. The arrows in the illustration indicate the triggering modes discussed above.

1–2–4–8 Binary-Coded Decimal Output

The −6 volt or 0 volt binary output levels, corresponding to the logic scheme in Figure 13, constitude a 1-2-4-8 binary code for the 0 to 9 count cycle. These voltages, as obtained from the collector of the left PNP or right NPN transistor of each binary (with reference to their location on the schematic) are used directly as the binary-coded decimal output at terminals F, H, J, and K of the connector CR505, CR506, etc. limit the negative level of the output to −6 volts.

Bi-Quinary Drive Circuit

Bi-Quinary circuit logic is used in the indicator drive circuit associated with each decade counting unit in the counter. The circuit consists of a binary stage which alternately energizes the even-numbered and odd-numbered anodes in the indicator with successive input pulses, and a "scale of five" circuit consisting of five transistors which turn on successively for a duration of two input pulses or "counts." Each of the 5 transistors control an odd and an even-numbered cathode in the indicator in the sequence of 0-1, 2-3, 4-5, 6-7, 8-9. The combined action of the binary and quinary circuits, therefore, produces the desired scale of 10.

Table 4-6 Scale of 5

Count	Binary Output Code		
	D_0	C_0	B_0
0,1	0	0	0
2,3	0	0	1
4,5	0	1	1
6,7	0	1	0
8,9	1	0	0

Table 4-7 Circuit Connections

Transistor	Input Connections		
Q511	D_0	C_0	B_0
Q512		C_0	B_1
Q513		C_1	B_1
Q514		C_1	B_0
Q515	D_1		

The bi-quinary circuit is driven by the output voltages of the "1-2-4-8" binaries of the basic decade unit. The "1's" or A binary of the decade drives the two transistors in the binary section of the bi-quinary circuit directly (Q500 and Q501 on drawing 10364). These turn on and off corresponding drivers Q516 and Q517 which ignite the indicator anodes. The quinary section is driven by the B, C and D binaries, the normal outputs of which form a scale of 5 as shown in Table 1.

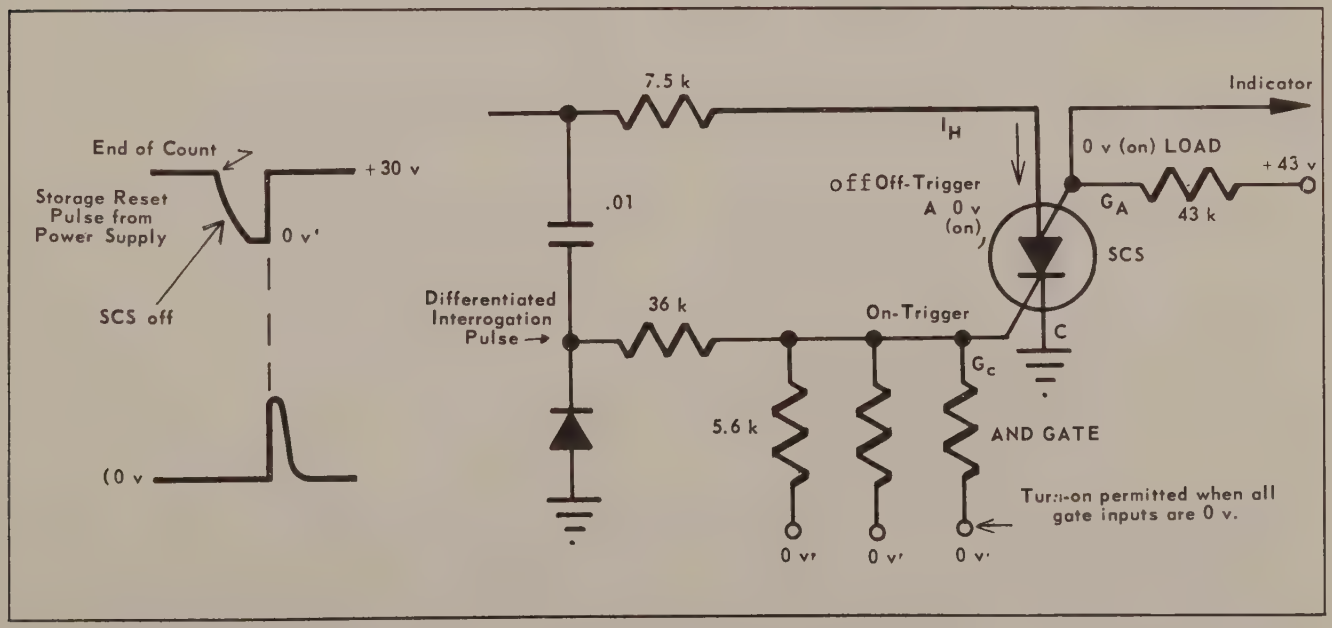


Figure 4-22 Storage Input Circuit and Waveforms

4-3-13 STORAGE DECADES (When included)

The storage type decade units employ Silicon-Controlled Switches (SCS) in place of transistors in the Bi-quinary drive circuitry. These SCS's require a special trigger input in addition to the normal "AND" gate inputs present before they will switch on and cause the corresponding numeral to indicate. The storage input circuit is shown in Figure 14. The "Storage Reset" waveform generated in the power supply at end-of-count is applied at terminal E. The negative-going edge of the pulse is coupled through the 7.5K resistor to the anodes of all the SCS's, turning them off, which removes the numeral display. The positive-going portion of the pulse, occurring less than 500 microseconds later, is differentiated by the .01 mfd capacitor into the sharp interrogation pulse also shown in Figure 14. This pulse is applied to the cathode gate (G_c) of each SCS, thus turning them on.

Once the SCS is turned on, its holding characteristics will keep it turned on, regardless of how the quinary gating signals may change. The indicator, therefore, will hold the count which has occurred at the end-of-count signal and will not indicate subsequent counts until the following end-of-count pulse.

4-3-14 2.5 MC DECADE (Refer to Dwg. 10364)

The 2.5 MC decade departs from the basic scheme described above in the following manner. In order to reduce capacitive loading which causes distortion of the squarewave needed for triggering at high frequencies, an emitter follower stage, Q518, is inserted at the output of Binary A. For the same reason, single mode triggering is used for Binary C. Binary B output, therefore, triggers Binary C to the "1" state on count 4 by coupling through C508 to Q507. Binary C is triggered back to the "0" state by the B, or reverse output of Binary B taken at the collector of Q504 and the emitter follower output which coupled through an AND gate to Q506 (C522 and CR520 paths).

Binary A (Q502/Q503) uses two extra diodes, CR501 and CR502, which provide DC restoring action to RC networks C500, R500 and C500, R501. This additional circuitry, together with the type of transistor used, improves the speed of response of the binary to accept 2.5 MC frequencies from the 10 MC decade. CR507 in the "inhibit" path serves a similar purpose. The output polarity of the 2.5 MC decade is inverted through Q510 to provide the correct polarity to operate the following 250 KC NPN type decade unit.

4-3-15 10 MC DECADE WITH GATE (Refer to Schematic 10552)

This circuit is identical to that referred to in 4.14 with the addition of the gate circuit consisting of transistors Q402 through Q404. The "count" signal passes through Q402 and Q404, when the gate switch is off (Q403). This occurs during the interval when the gate level input is high (0 volts) after the occurrence of a start signal. When the gate level drops to -6 volts after the occurrence of a stop signal, Q403 saturates, grounding out the "count" signal at its collector.

4-3-16 250 KC DECADE (Refer to Schematic 10363)

The logic and circuitry are essentially as described in 4.12, except that NPN type transistors are used which requires opposite bias and signal polarities.

4-3-17 DECADE UNIT SERVICING GUIDE

The following trouble-shooting guide refers to circuit detail numbers in the 2.5 MC decade. By transposing the transistor reference numbers, it may also be applied to the 10 MC, 250 KC, and x10 decades. The 10 MC decade symptoms will not correspond fully to those listed. The symptoms may occur somewhat less predictably than presented in the table.

A transistor may not conduct, for example, because it is open, the complementary transistor is leaky, or the associated steering diode is open.

	Symptom	Causes
a.	Reads out even numbers only	Q520 or Q500
b.	Reads out odd numbers only	Q519 or Q501
c.	Locks on any even or odd number	Q505 or Q506
d.	Alternates between 0 and 1	Q507, 508, 509, 512 or 513
e.	Alternates between 2 and 3 (See "f" and "g" below)	Q508 or Q509
f.	Cycles: 0-1-2-3, or alternates: 2 and 3	Q510 or Q511
g.	Cycles: 0 through 7, or alternates: 2 & 3 or 6 & 7	Q512 or Q513
h.	Alternates with dual illumination: 0 1, 2 3, 4 5, 6 7, 8 9, etc.	Q500, 501, 519, or 520
i.	Two numbers indicate simultaneously	Leaky bi-quinary drive transistor related to numeral which is out of sequence.

Table 4-8 Decade Units Trouble Symptoms Guide
(Detail numbers refer to 2.5 MC decade)

Chapter 5 — MAINTENANCE

5-1 CALIBRATION & ADJUSTMENT PROCEDURE

5-1-1 TEST EQUIPMENT REQUIRED

To perform the trouble-shooting and maintenance tests described in this manual, the following test equipment is recommended:

a. Oscilloscope, 15 Mc bandwidth (Tektronix Model 531 with Type C plug-in amplifier or equivalent).
b. Signal generator, 0 - 15 Mc sinewave (General Radio Model 1330A or equivalent).
c. Signal generator, 0 - 1000 cps sinewave (Donner 1202 or equivalent).
d. Square wave generator, 0 - 50 Mc output (Hewlett-Packard Model 211A or equivalent).
e. Volt-Ohmmeter, Simpson Model 260 or equivalent.
f. Variable line voltage transformer ("Variac").
g. 1 Mc standard frequency source.
h. Extension cards for plug-in modules (See "Accessories" in Appendix).

5-1-2 GENERAL CALIBRATION & TEST PROCEDURE

Routine performance of the following tests will assure that the counter is operating within its rated specifications.

NOTE:
Remove the top and bottom covers to gain access to all test points and adjustments.

1. ***Preliminary:*** Turn on AC power. Look for symptoms of overheating in the power supply. Note that the fan operates and the POWER and OVEN lamps are on. If trouble is observed, turn off AC power and remove all plug-in circuit cards. Measure resistance to ground at the output voltage printed circuit buss wires connecting to the underside of J101. (V = −30v, W = +30v, R = −6v, T = +6v, Y = +43v, Z = +225v, N = ground.) All should measure greater than 100 K ohms.

2. ***Power Supply Adjustments:***
   a. Measure the voltage at the −30v bus and adjust R131 on the regulator card for a reading of −30.0 volts. Repeat the measurement at the +30v bus and adjust R112 for the correct reading of +30.0 volts.
   b. Measure the −6v output and adjust R120 for +6.0v.
   c. Measure the +6v output and adjust R104 for +6.0v.
   d. Measure the +225v and adjust R102 for a correct reading of +225v.
   e. Measure +43v output (no adjustment).

3. ***Oscillator Adjustment:***
   a. Monitor the output at the "1 Mc" jack at the rear with the oscilloscope. An undistorted sinewave should appear of 2.8v peak-to-peak. Adjust the output level by means of R801 on the oscillator-multiplier card.
   b. Apply a Mc signal from the output of the 1Mc frequency standard to the A input amplifier jack and turn the function selector to "RATE." Set the time base to 0.1 cps. Adjust the trimmer capacitor located in the top of the crystal until the indicators register exactly (1) 0000000 +1 count over an indefinite period of time. (The "1" does not appear on the register except with Option E.) For a precise adjustment use the procedure outlined in section 4-3-6.

4. ***10 Mc Multiplier Adjustment:*** (Model 1034 only)
   a. Note: The 10 Mc multiplier adjustments should not be disturbed unless the 10 Mc output signal is lost. Using the oscilloscope, check that 1 Mc is present at the base of Q804.
   b. Move the scope input to the base of Q805 and check if a 5 Mc signal is present. If not, adjust L801 ("x5") for maximum amplitude.
   c. Next, adjust L802 ("x2") for maximum amplitude of the 10 Mc signal at the base of Q807.
   d. Adjust L803 ("10 Mc") for maximum amplitude of the 10 Mc signal at the Time Base Out jack, using the 0.1 μ sec time base.
   e. Readjust all three controls for maximum amplitude at the Time Base Out jack.

5. ***Channel A Trigger Level Check:***
   a. Turn the Function switch to "Count" and the A SLOPE to "+". Rotate the A trigger control to the "−" extreme and press the RESET button. Slowly rotate the Trigger control to the "+" extreme. The counter should not start counting.
   b. Slowly rotate the A trigger level control towards the "−" extreme. The indicators should register one count ***only*** as the trigger control index passes the "0" mark. If necessary, adjust the A trigger zero screwdriver control (R108) for the correct setting. (See Step 7)
   c. Reverse the A SLOPE switch to "−" and repeat this check, reversing the rotation of the Trigger Level control.

6. ***Channel B Trigger Level Check:***
   a. Place the Function switch at TIME B-A. Set both slope switches to "+" and both Trigger Level controls to the "+" extreme.
   b. Rotate the A control to the "−" extreme. The 1034 should start counting as the Trigger Level index passes "0".
   c. Rotate the B Trigger Level towards the "−" extreme. The counter should stop counting as the Trigger index passes "0" and then reset.

7. ***Trigger Level Zero Adjust:***
   a. Apply a low frequency sinewave to the channel input. Set the Trigger Level control to "0". Observe the squarewave marker output on an oscilloscope.
   b. Adjust the Trigger Zero Adjust (R108 or R208) for symmetrical positive and negative portions of the squarewave.
   c. For the A channel only, the trigger zero adjust may be set conveniently as follows: Make a period measurement of a low frequency input signal with the A and B Slope switches first at the same polarity and

then at opposite polarities. The second reading should be exactly one-half the time indicated by the first reading.

8. ***Sensitivity and Frequency Range:***

a. Apply a 5 Mc sinewave signal of 0.3 volts peak-to-peak amplitude to the A input. Turn the Function selector to RATE and use a 0.1 second time base. Adjust the A trigger level for a stable indication. The counter should cycle continuously and register a count of approximately 5000.00 Kc. Because of the instability of the sinewave generator, the two far-right digits may vary from one indication to the next.

b. If the count is not stable at 5 Mc slowly decrease the frequency while adjusting the trigger level control until a stable count is achieved. If this count is below 5 Mc, check the A amplifier and/or the 10 Mc decade for proper operation.

9. ***Period A:***

a. Apply a 100 cps sinewave of 0.3v peak-to-peak (using the Model 1202) to the input of the A amplifier. Set the Function switch to PERIOD A and both Slope switches to "–". Use a 1 μ sec (1 Mc) time base frequency. Adjust the trigger level for a stable count. The indication should be approximately 10,000 microseconds (0010000).

b. Change to a 0.1 μ sec time base. The indication should be ten times larger (0100000).

c. Change both Slope switches to "+". The indication should not change.

d. Change to the "Period x10" mode. The indication should be ten times larger than in Step c. (1000000).

e. Change to the "Period x100" mode. The indication should be 100 times larger than step c.

10. ***Time B-A:***

a. Keep the 100 cps input. Set both Slope switches to "+" and the SEP-COM switch to COM. Change to the TIME B-A function and adjust the B trigger control for a stable count indication of approximately 0100000, using the 0.1 μ sec time base.

b. Change both slope switches to "–". The indication should remain the same.

c. Change the B slope switch to "+" and note the reading.

d. Change both slope switches to the opposite polarities and again note the reading. The sum of the readings in steps c and d should equal the reading in step a. Return both slope switches to "+".

11. ***Gate Function:*** (Model 1926 only)

Keep the 100 cps input to channels A and B and apply a 1 Mc sinewave of 3v peak-to-peak to the GATE input. Switch to the GATE function. The indication should be approximately 0010000.

12. ***Ratio A/B Function:***

a. Change the SEP-COM switch to "SEParate" and the Function selection to RATIO A B. Apply a 1 Mc sinewave of 0.3v peak-to-peak to the A input jack and the 100 cps sinewave of 0.3v peak-to-peak to the B input. The indication should be approximately 0010000.

13. ***Decade Check:***

a. Set the Function switch to "TIME B-A" but remove the existing input to the B input jack. Set the Time Base selector to 1 sec and observe that the first indicator (far right) cycles sequentially from 0 through 9. Look for symptoms of defective bi-quinary drive circuitry (two numbers lighting at once, faint glow).

b. Change the time base frequency to 10^{-1}. Observe the second indicator to confirm the proper sequence of numbers. Repeat the test for the remaining indicators, each time using a time base frequency ten times higher than the previous one.

14. ***Time Base Output:***

Attach the oscilloscope to the "Time Base Out" jack. Rotate the Time Base switch through its range and note that the frequency on the oscilloscope corresponds to the frequency selected by the Time Base switch. The output should be 3v, peak-peak, minimum in all positions. (Typical reading is 6v peak-peak.)

15. Place the EXT-INT switch in the EXTernal position. Apply a 1.0v rms 1 Mc signal to the 1 Mc jack on the rear panel. Repeat step 14. Return the switch to the "INT" position. Note the presence of a 1v rms minimum 1 Mc signal at the 1 Mc jack.

16. ***Input Amplifier Marker Output:***

Apply a signal to the A and B input amplifiers and note that a rectangular waveform of the same frequency appears at the test point (A OUT or B OUT) on the front panel of the amplifier Module. At "0" trigger level, the waveform should become a squarewave.

17. ***Power Supply Ripple and Noise:***

Monitor the output voltages at the power supply voltage regulator and rectifier board with the oscilloscope. Note that the ripple frequency is 120 cps, ***not*** 60 cps.

Ripple must not exceed 0.5v peak-peak and noise must not exceed 200 mv peak-peak on any bus.

18. ***Power Supply Regulation:***

a. Connect the Variac in the AC power input to the Model 1034 and reduce the line voltage to 100v. Repeat step 3 in part to confirm operation and re-check ripple and noise as in step 17.

b. Change the input line voltage to 130v and repeat step 18a for the identical requirements.

19. ***Display Interval:***

Place the Function switch in TEST and select a 1 second time base. Turn the DISPLAY control to maximum without closing the "infinity" switch. Depress the Reset button and then release. The counter should cycle one time and hold its indication for at least 5 seconds before it recycles. Close the "infinity" switch and note that the counter will not recycle.

20. ***Blanking:***

Turn on the BLANKING switch while in the TEST function and observe that the indicators display only the final count and remain unlit otherwise.

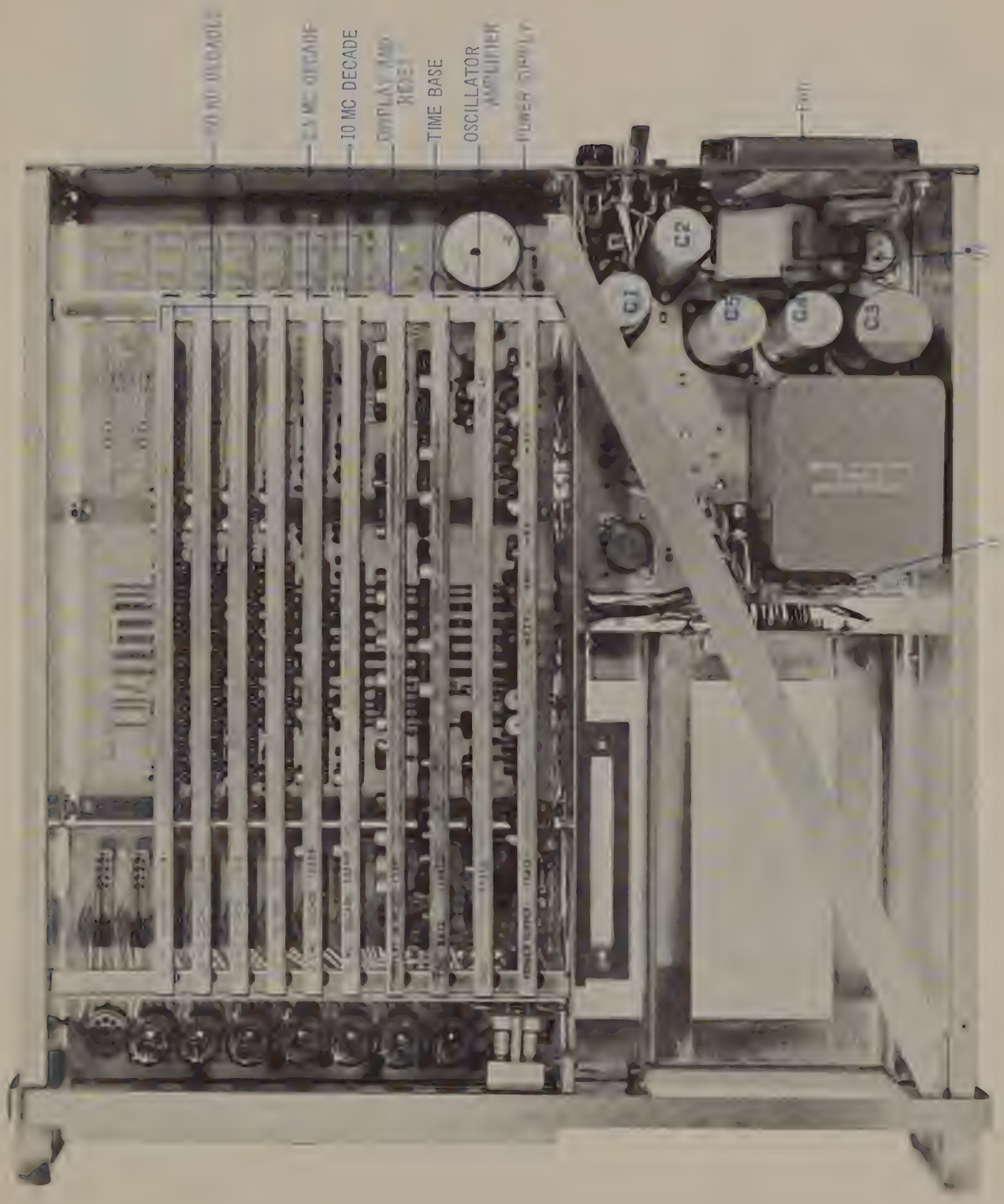
21. ***Oscillator Drift:***

Allow the counter to remain on continuously for at least two hours after the initial oscillator adjustment in step

3. Re-measure the oscillator frequency as in step 3b. Frequency error should not exceed 1 part in 10^7, or a total of ±2 counts. Spot checks should be made at half-hour intervals until stability has been satisfactorily established.

5-1-3 INPUT ATTENUATOR ADJUSTMENTS
(Model 1926)

1. Use an extension board or cable, if available, to connect the Model 1926 to the counter. Apply power. Place the scope probe at the cathode of V101 in "A" amplifier.
2. Select AC coupling and an attenuation of "3". Apply a squarewave output voltage of 5v peak to the A input jack.
3. Adjust C9 on the Model 1926 amplifier plug-in unit to obtain the fastest rise time (best square waveform).
4. Switch attenuator to "1" and adjust C7 for the best square wave.
5. Repeat the procedure for the B amplifier channel. (Adjust C22 and C20, respectively).



Top View of Model

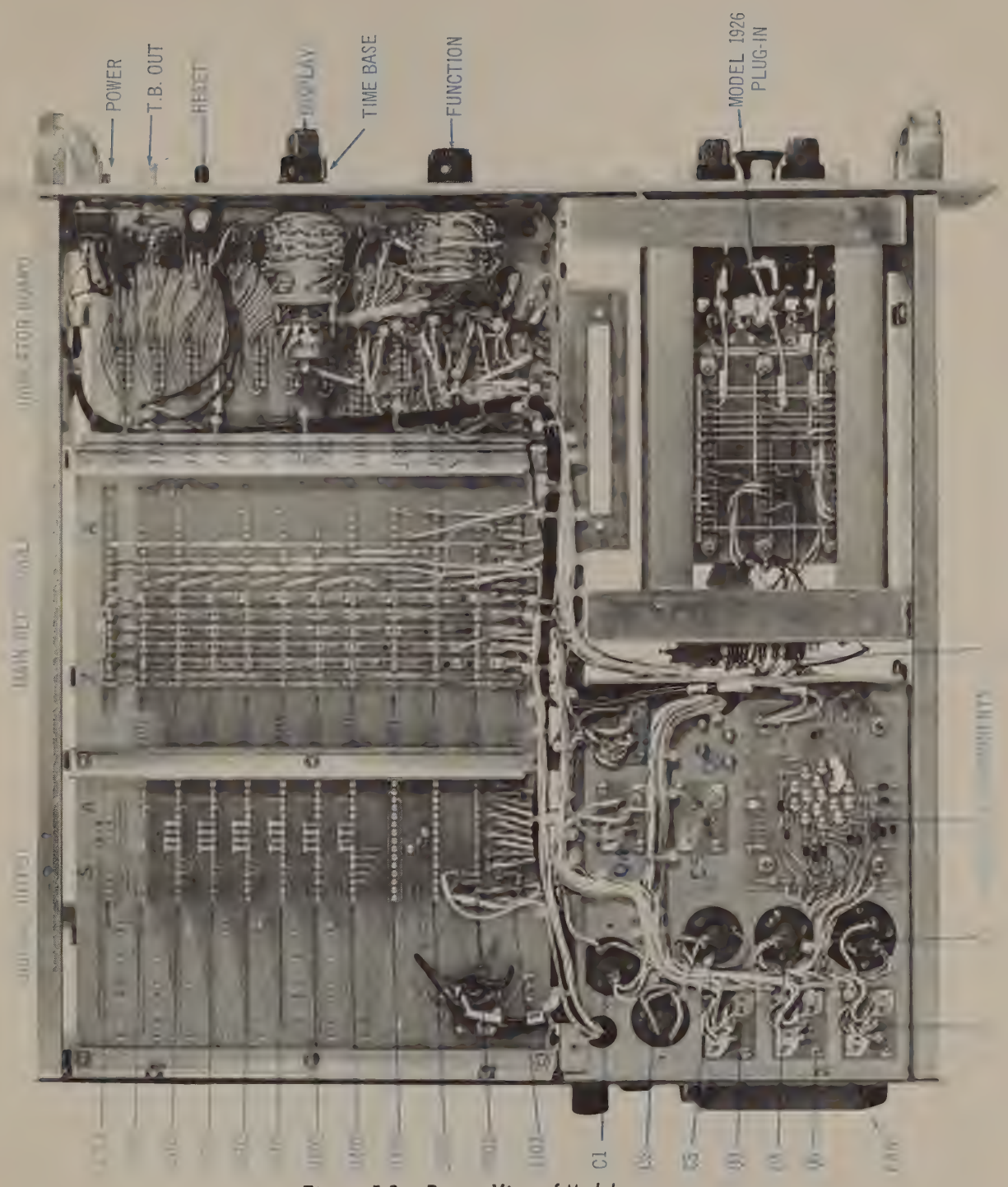
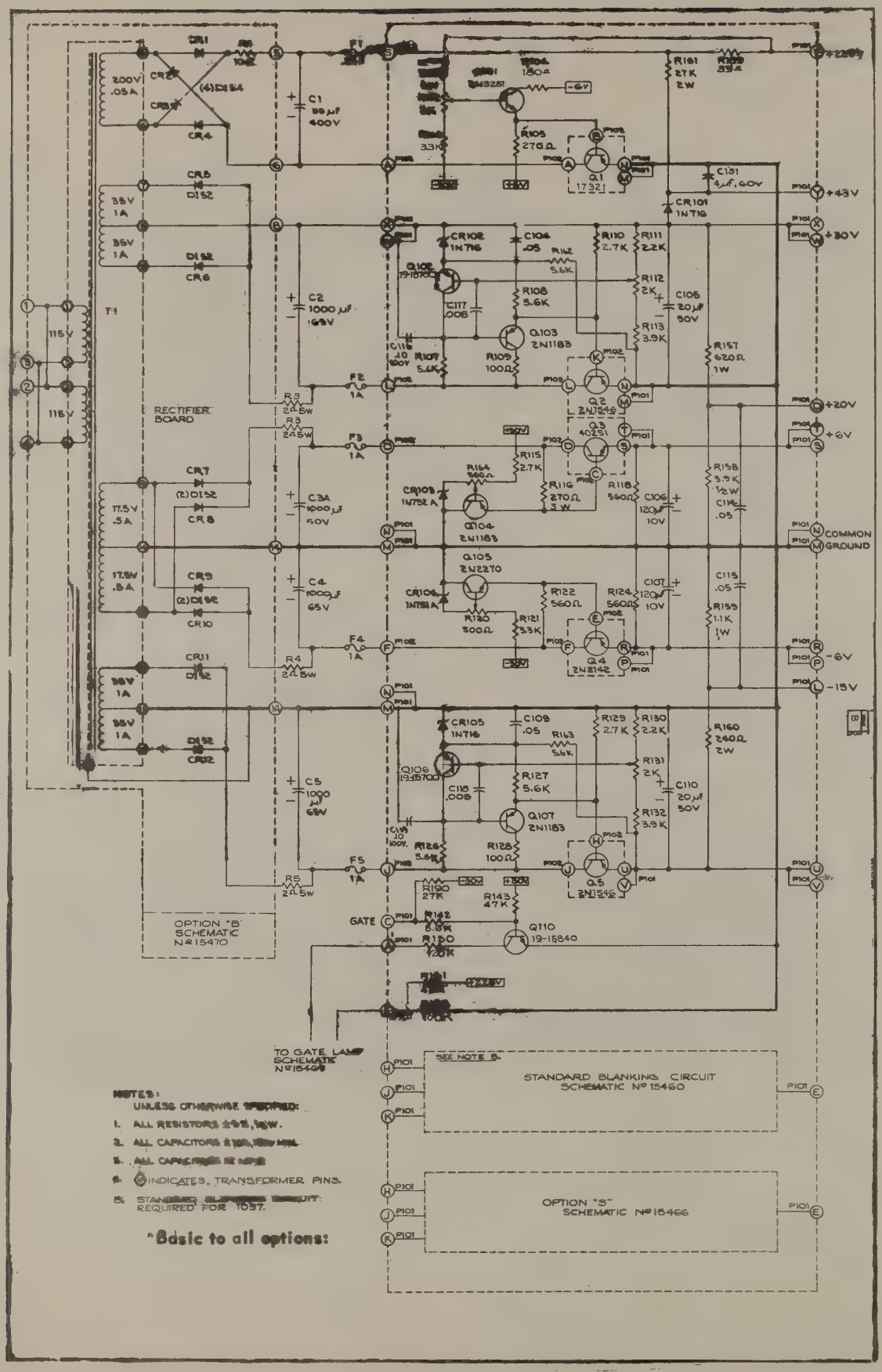


Figure 5-3 Bottom View of Model



Basic Power Supply Schematic No. 15413

(REV 1-66)

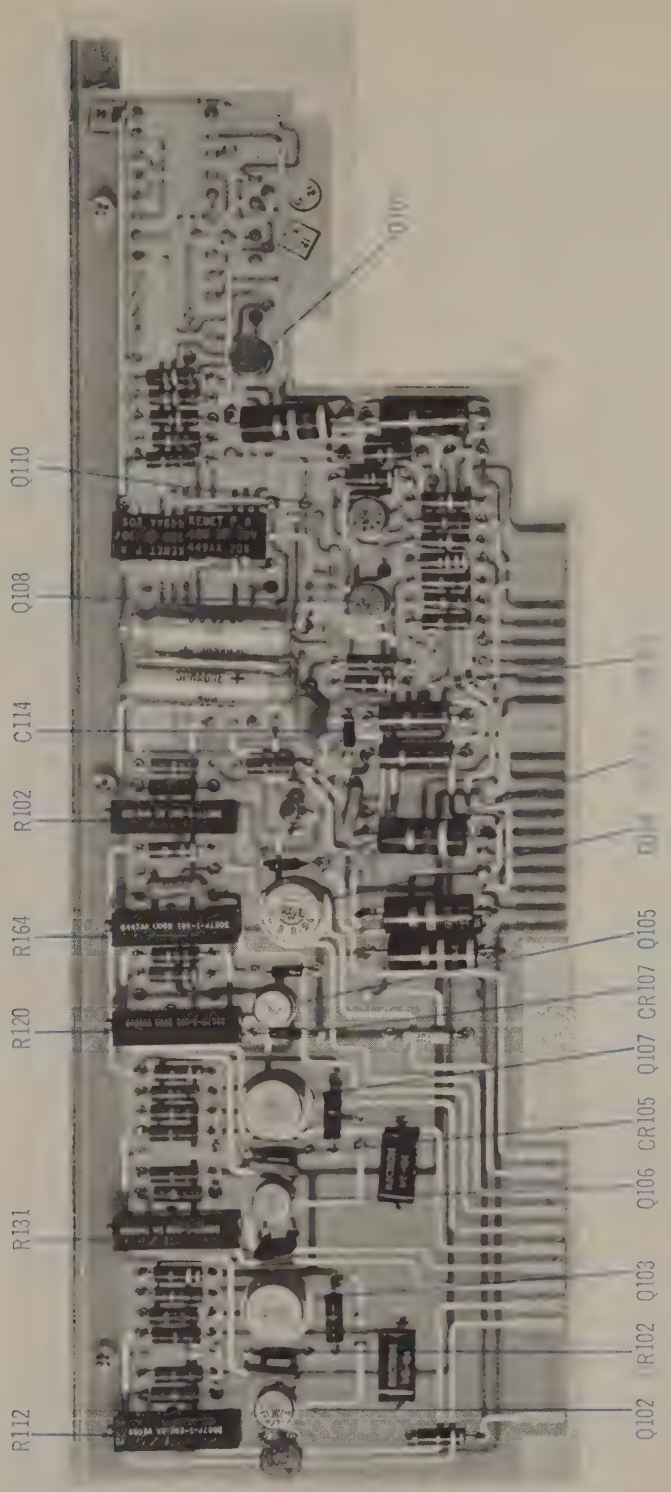
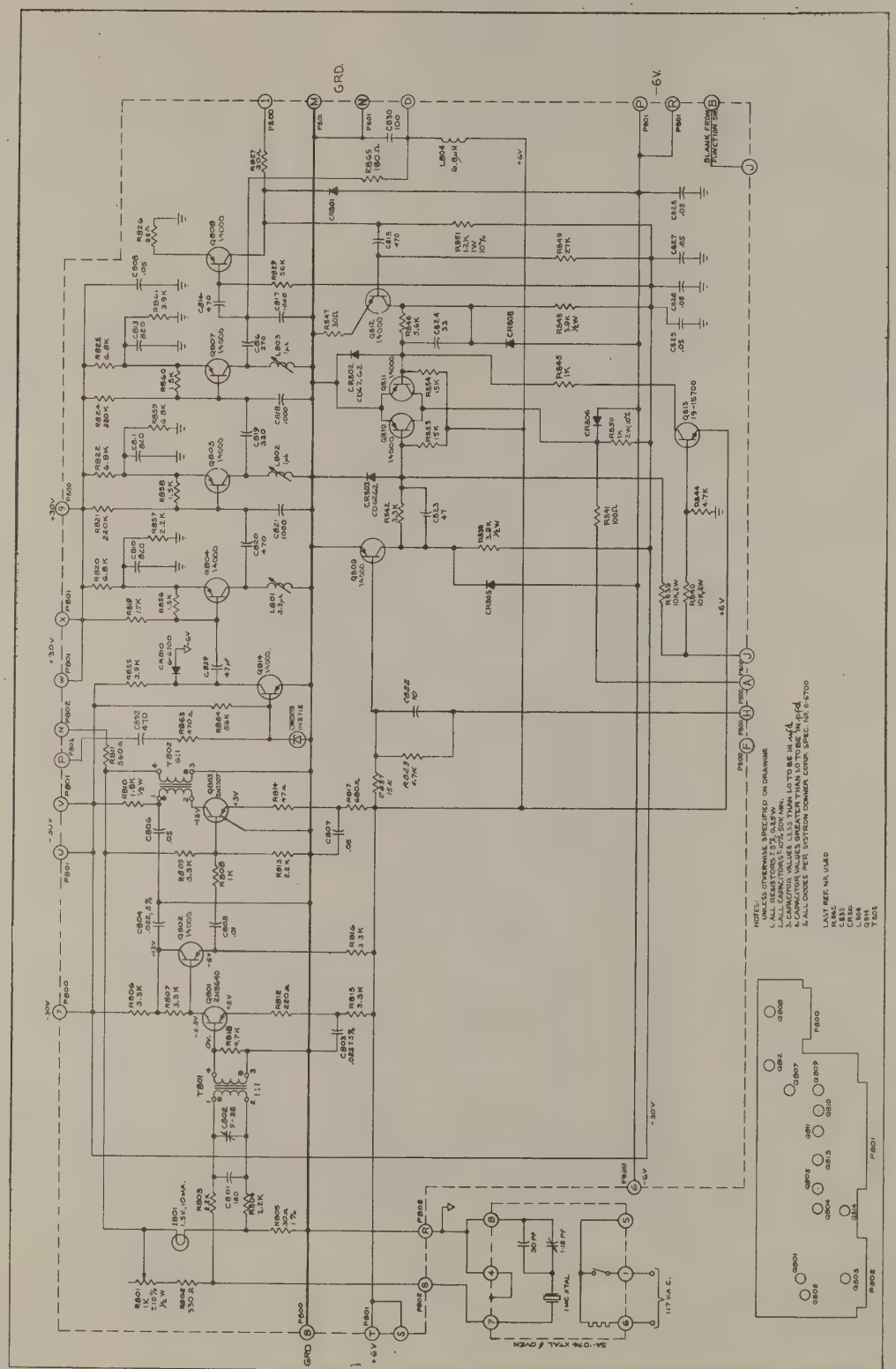


Figure 5-4 Power Supply



Standard Oscillator Multiplier Schematic No. 10555

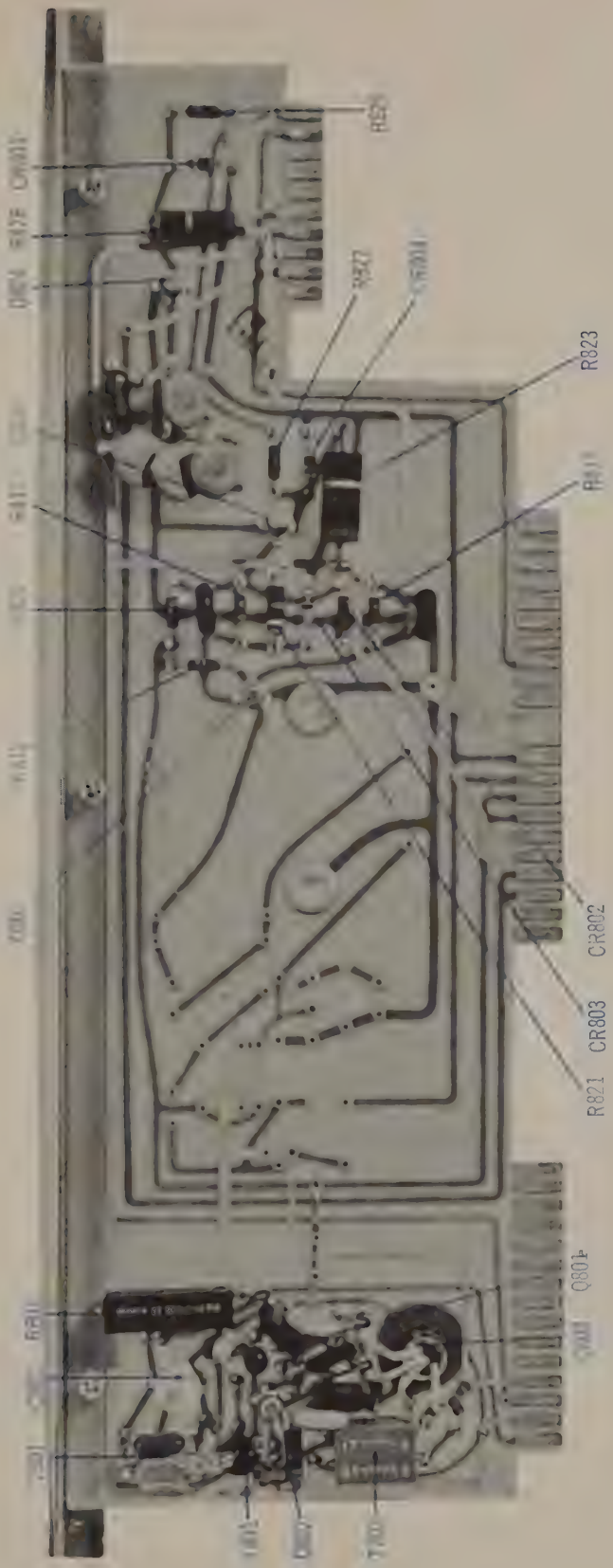
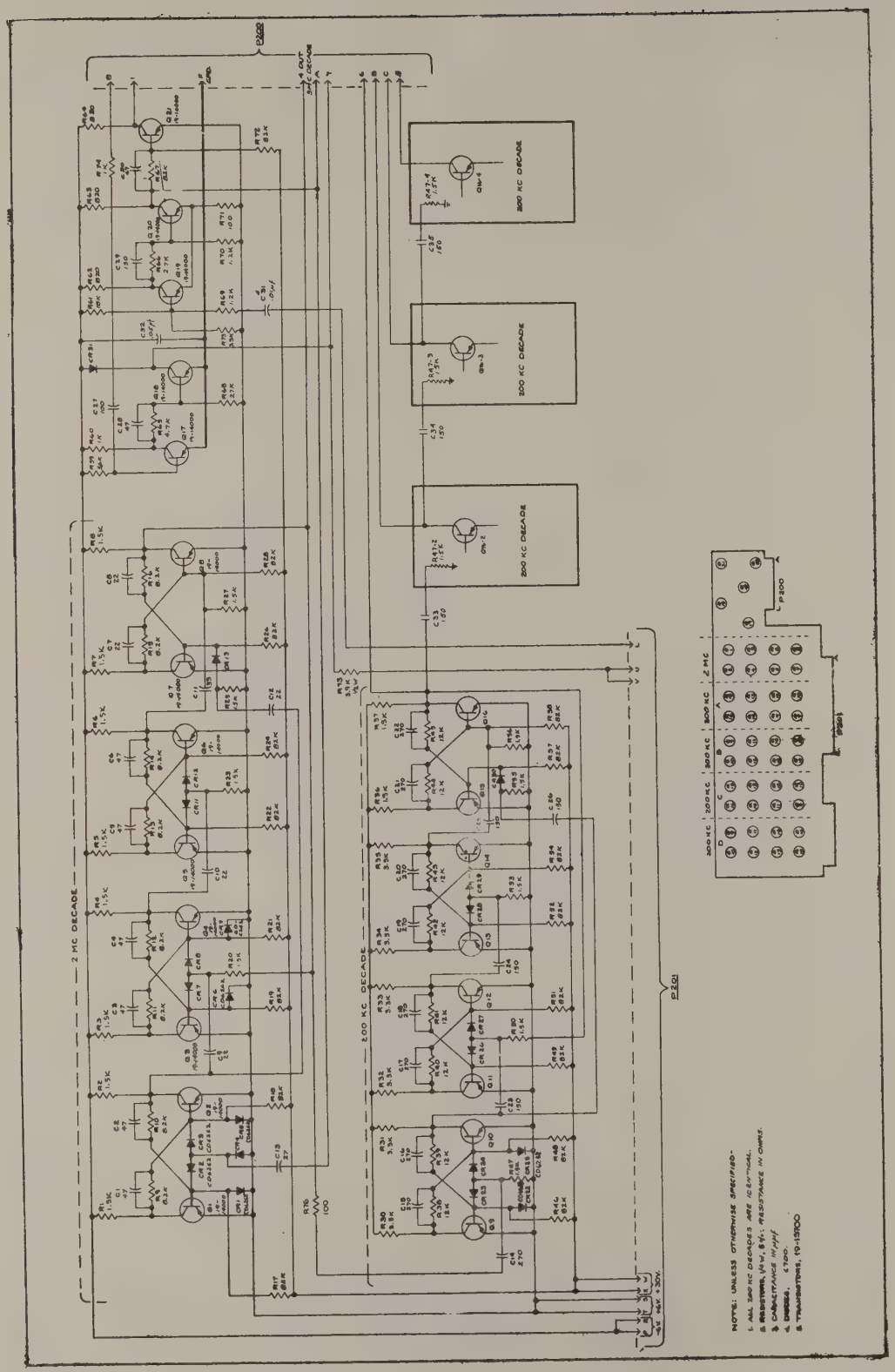


Figure 5-5 Parts Identification, Oscillator and Amplifier



Time Base Divider Schematic No. 15423

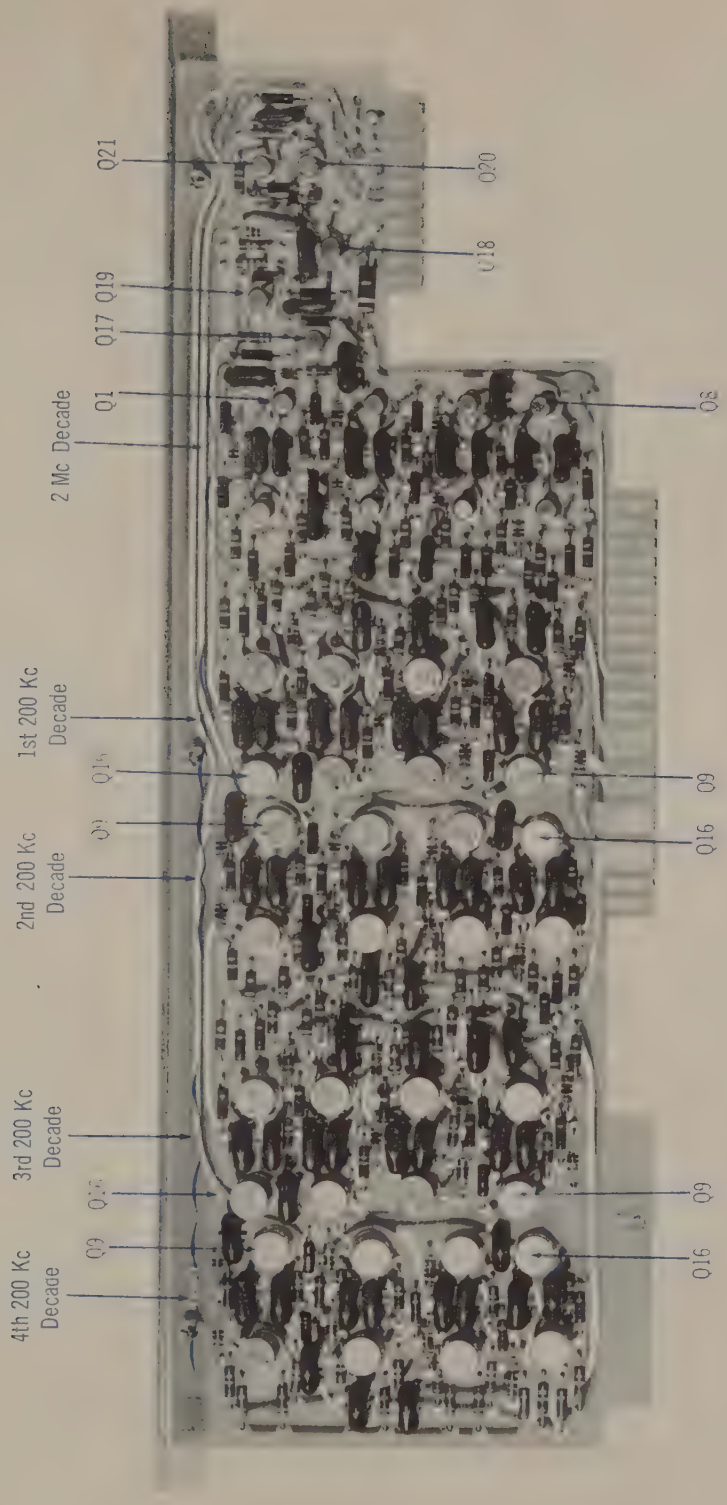
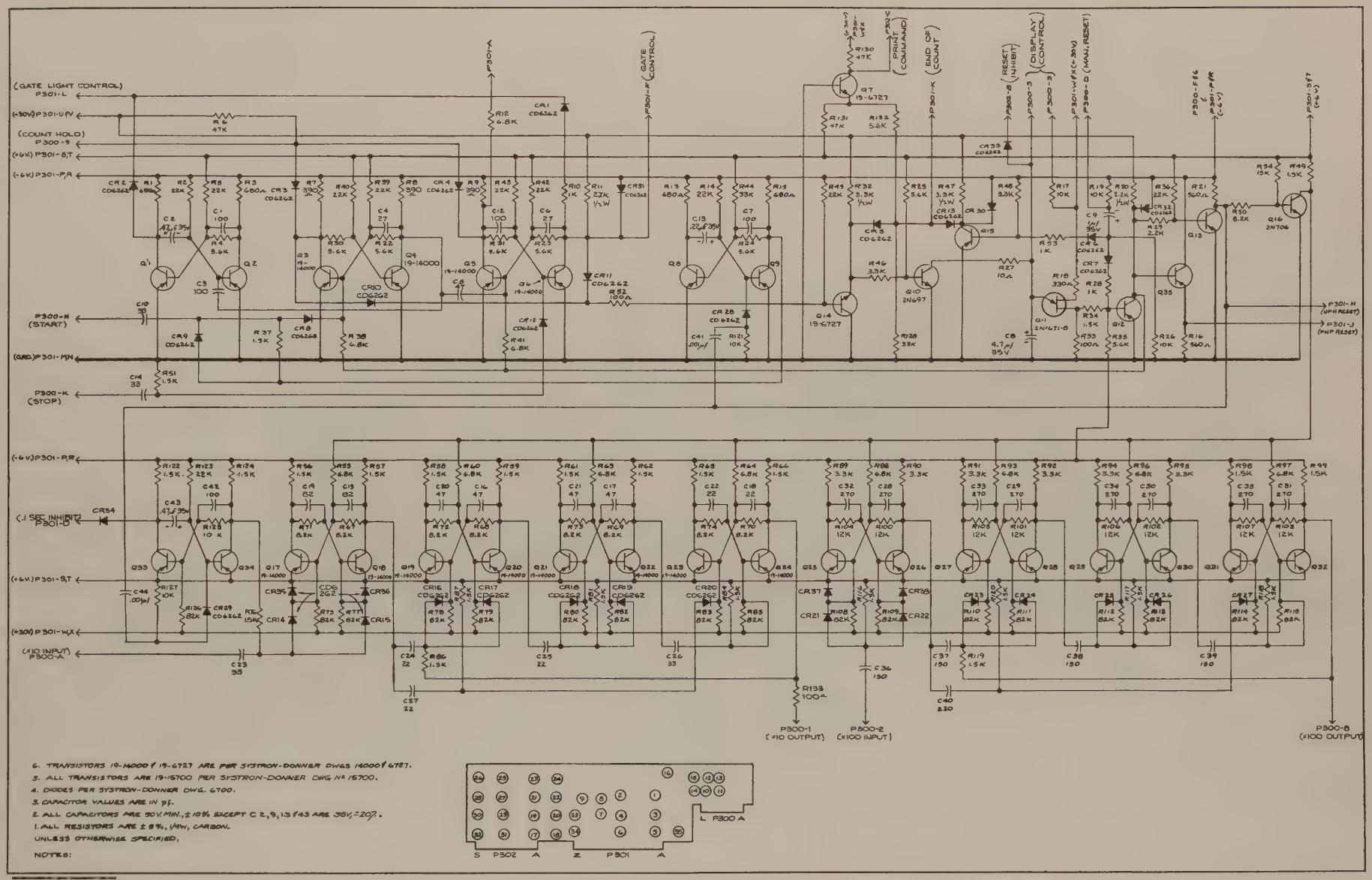


Figure 5-6 Time Base



NOTES:

1. ALL RESISTORS ARE ± 5%, 1/4W, CARBON.
2. ALL CAPACITORS ARE 50V MIN., ± 10% EXCEPT C 2, 9, 13 & 43 ARE 35V, -20%.
3. CAPACITOR VALUES ARE IN μf.
4. DIODES PER SYSTRON-DONNER DWG. 6700.
5. ALL TRANSISTORS ARE 19-15700 PER SYSTRON-DONNER DWG Nº 15700.
6. TRANSISTORS 19-14000 & 19-6727 ARE PER SYSTRON-DONNER DWGS 14000 & 6727.

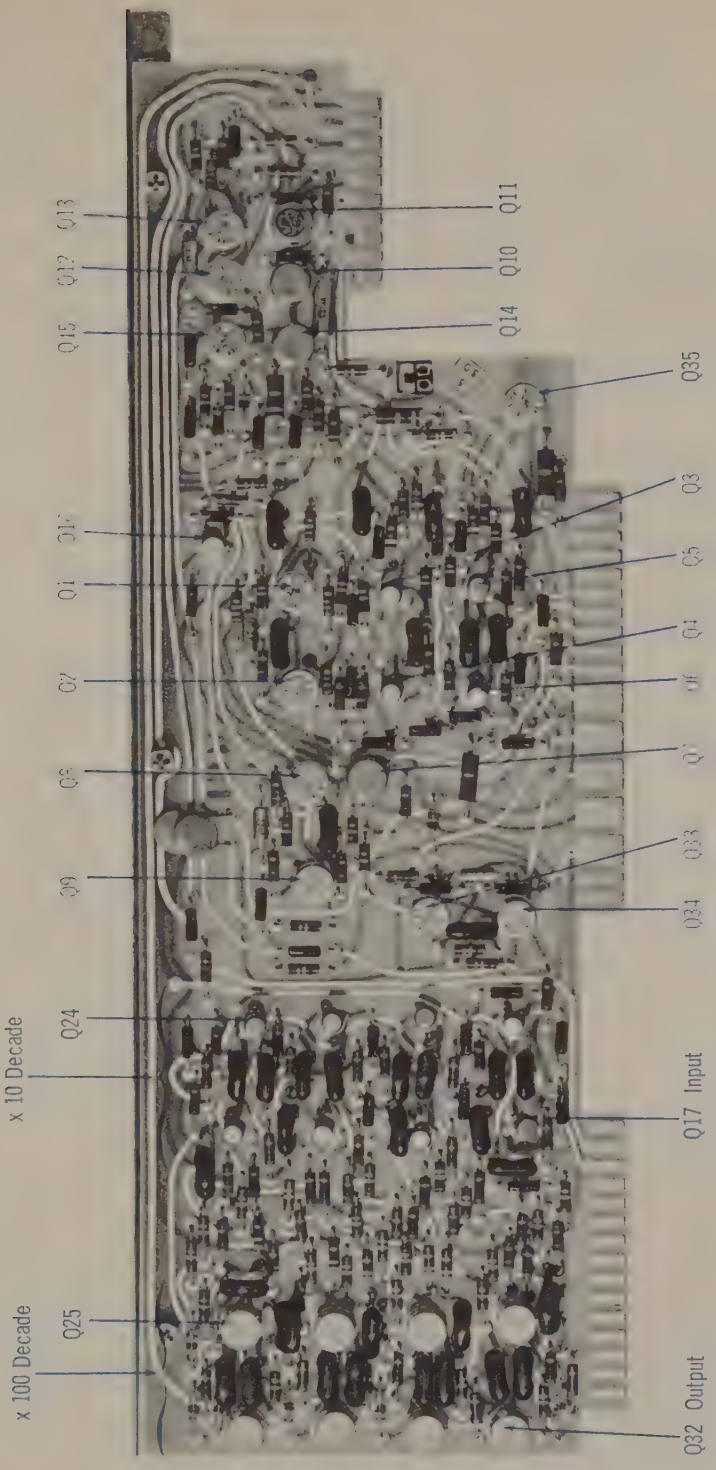
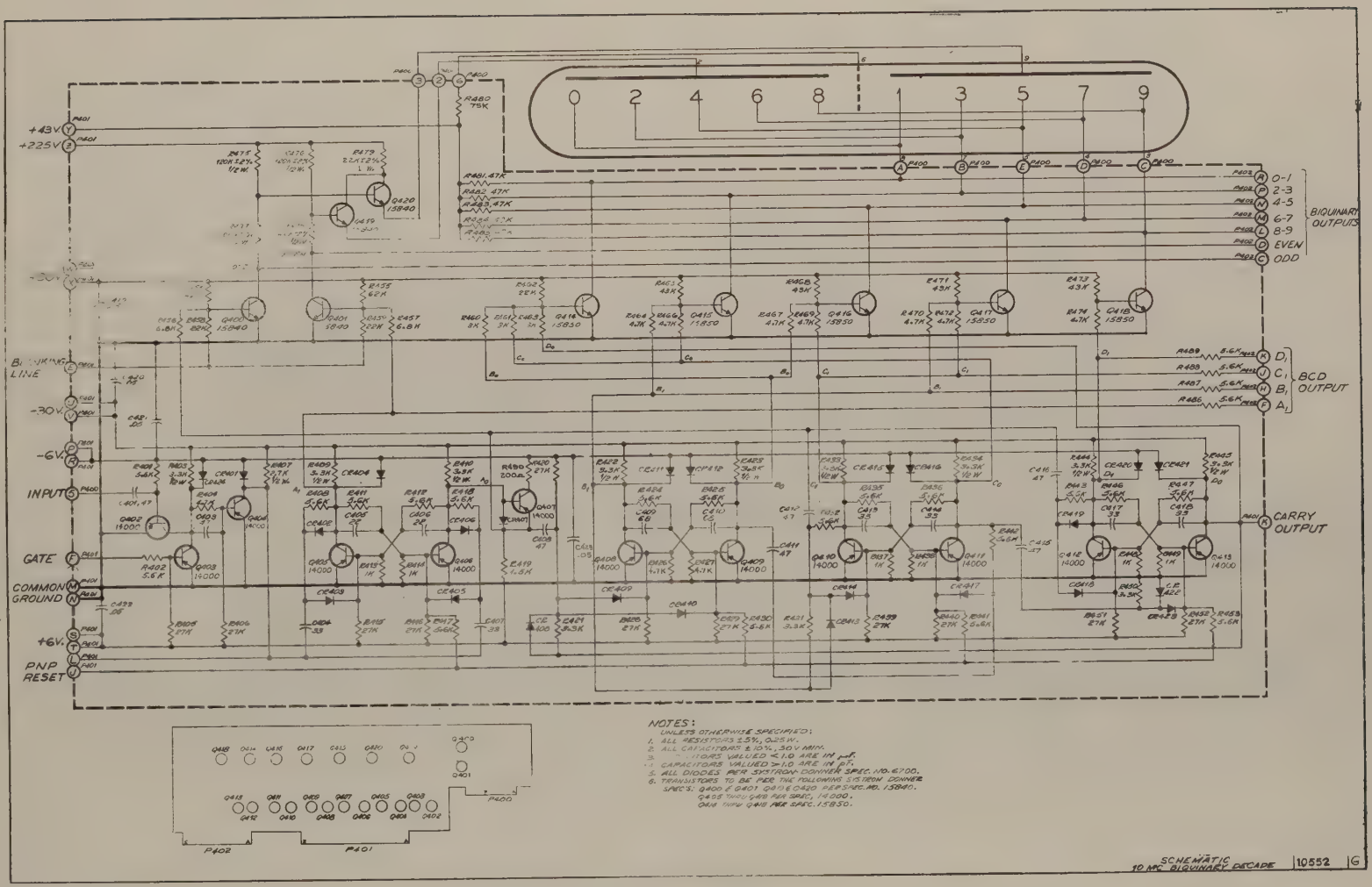


Figure 5-7 Parts Location – Display and Reset


0 2 4 6 8 1 3 5 7 9
+43V
+225V
-30V
-6V
INPUT
GATE
COMMON GROUND
+6V
PNP RESET
BI LINE
BIQUINARY OUTPUTS
0-1
2-3
4-5
6-7
8-9
EVEN
ODD
BCD OUTPUT
CARRY OUTPUT
NOTES:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ±5%, 0.25 W.
2. ALL CAPACITORS ±10%, 30 V MIN.
3. RESISTORS VALUED <1.0 ARE IN mf.
4. CAPACITORS VALUED >1.0 ARE IN pf.
5. ALL DIODES PER SYSTRON DONNER SPEC. NO. 6700.
6. TRANSISTORS TO BE PER THE FOLLOWING SYSTRON DONNER SPECS: Q400 & Q401 Q410 & Q420 PER SPEC. NO. 13840. Q405 THRU Q409 PER SPEC. 14000. Q411 THRU Q418 PER SPEC. 15850.
P402
P401
P400
SCHEMATIC
10 MC BIQUINARY DECADE
10552 G

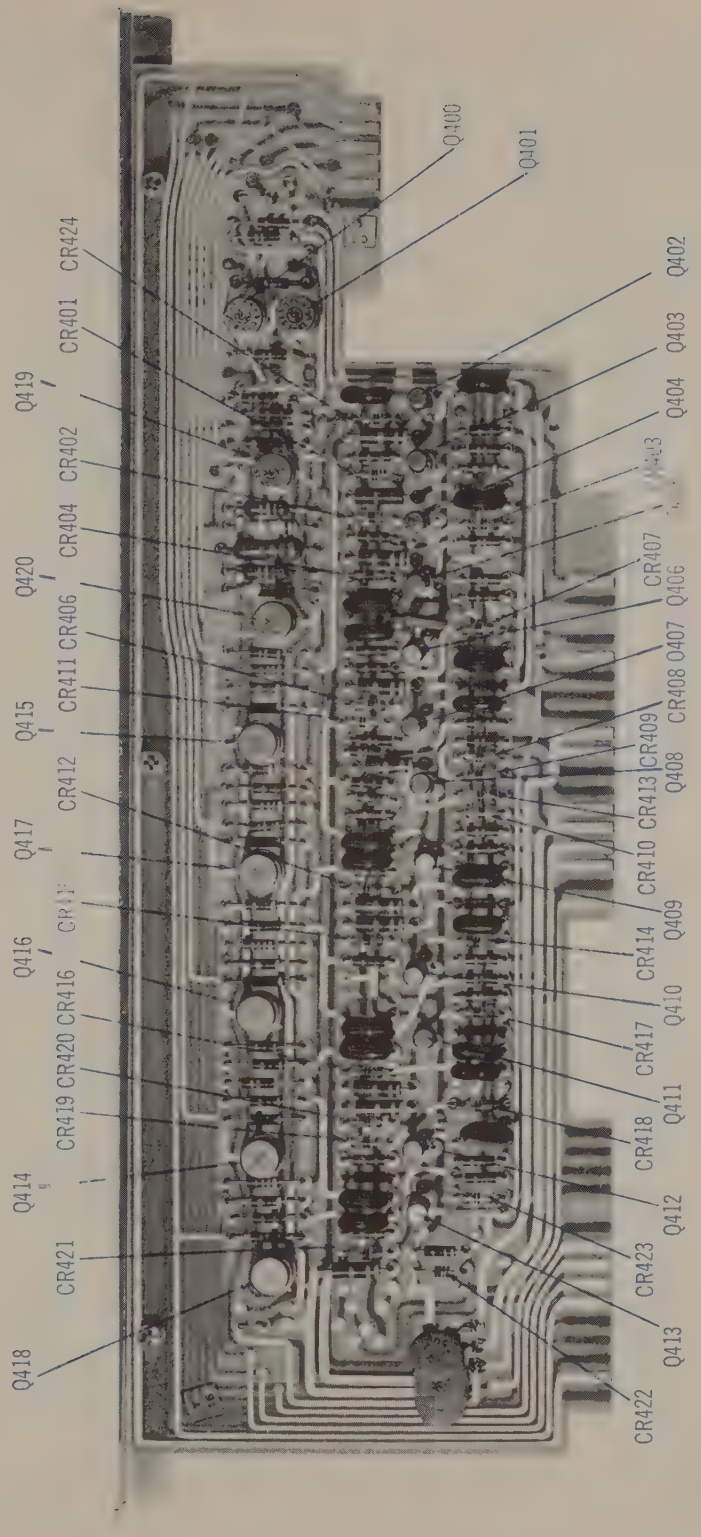
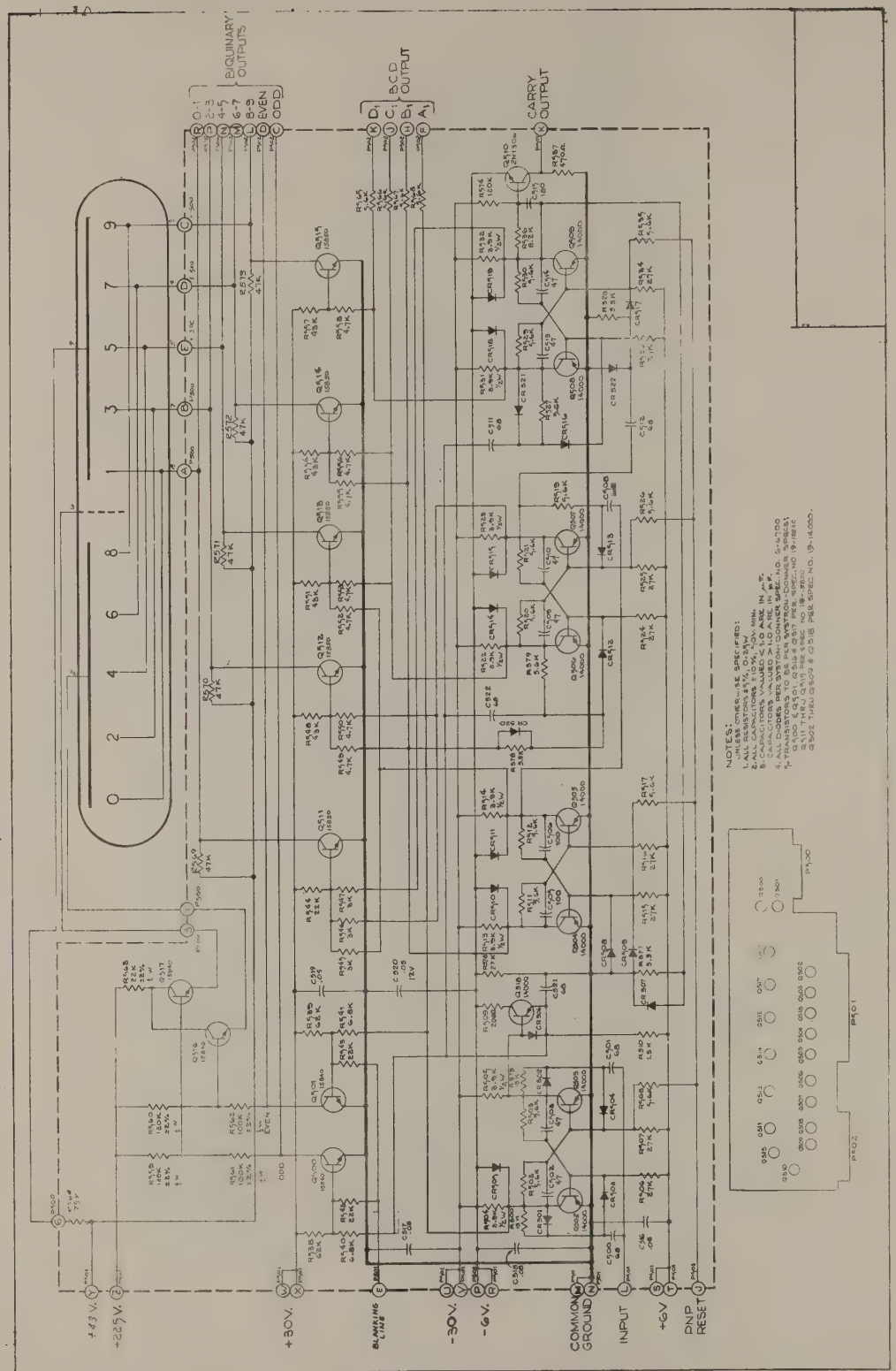


Figure 5-8 10 Mc Decade



2.5 Mc Standard Decade Schematic No. 10364

(1-66)

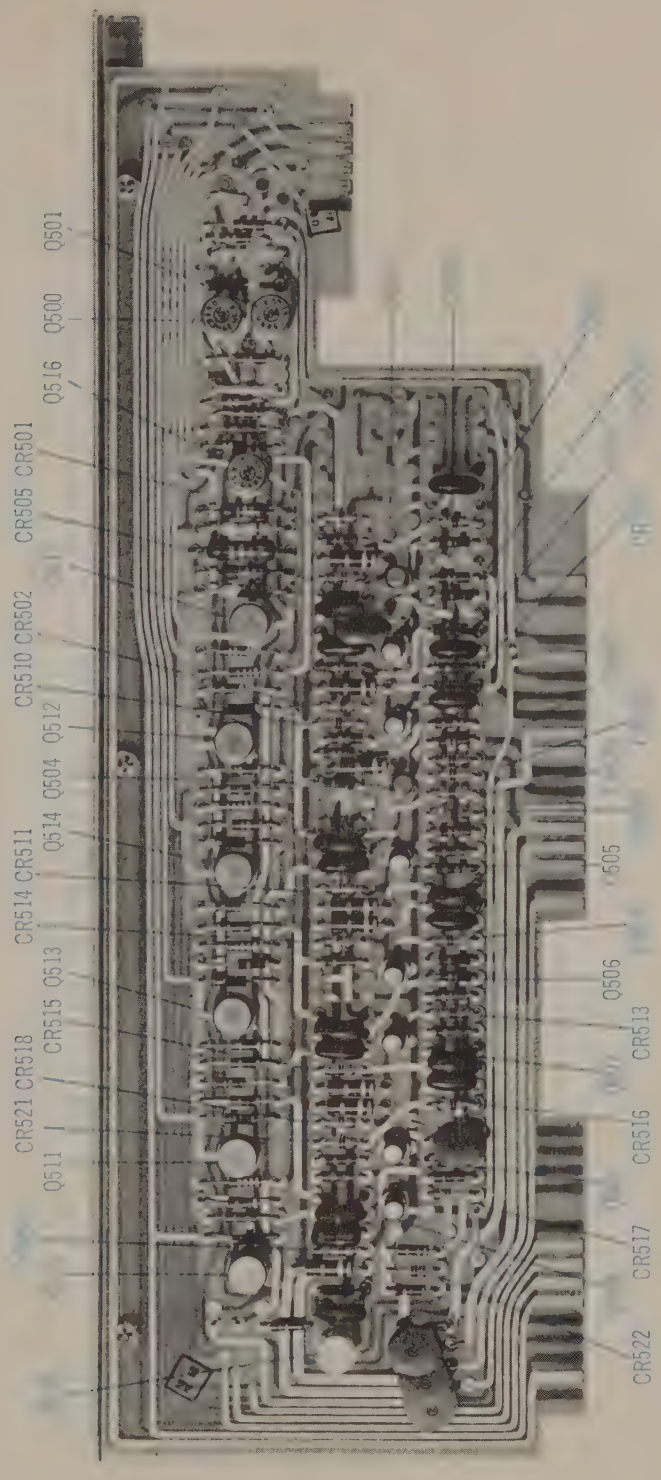


Figure 5-9 2.5 Mc Decade

PARTS PROCUREMENT

To obtain replaceable parts, address order or inquiry to the nearest Systron-Donner Engineering Representative, or part manufacturer as applicable. The names and addresses of the Systron-Donner Engineering Representatives located in the continental United States and Canada are listed on the last page of this manual. Please supply as much of the following information as possible when ordering parts.

a. Systron-Donner Stock Number
b. Part Description
c. Part Function and Location

SYS-DON PART NO.	DESCRIPTION	MANUFACTURER - PART NO.
CAPACITORS		
C-0235	.001 uf, 3/8" max.	Centralab DD102
C-0325	.005 mf, 10%, 150v, ceramic disc	Centralab DDM-502
C-0354	.22 uf, 20%, 35v	Astron TESP-22-35
C-0406	4.7 uf, 35v, solid tant.	Texas Instru. SCM475BP035A4
C-0417	4 uf, 30v, tant. +75 -15%	G.E. 62F208
C-0441	.01 uf, 400v, ±20%, mylar foil	Hopkins P014MF
C-0524	1.0 uf, 35v, ±20%, tant.	Texas Instru. SCM105FP035D4
C-0527	10 pf, 10%, 500v, dipped silver mica	ElMenco DM-15C-100K-500v
C-0528	15pf, 10%, 500v, dipped silver mica	ElMenco DM-15-C-150K-500v
C-0529	22pf, 10%, 500v, dipped silver mica	ElMenco DM-15C-220K-500v
C-0530	27pf, 10%, 500v, dipped silver mica	ElMenco DM-15C-330K-500v
C-0531	33pf, 10%, 500v, dipped silver mica	ElMenco DM-15E-470K-500v
C-0533	47pf, ±10%, 500v, dipped silver mica	ElMenco DM-15E-820K-500v
C-0535	82pf, 10%, 500v, dipped silver mica	ElMenco DM-15E-820K-500v
C-0536	100pf, 10%, 500v, dipped silver mica	ElMenco DM-15F-101K-500v
C-0537	150pf, 10%, 500v, dipped silver mica	ElMenco DM-15F-151K-500v
C-0538	220pf, ±10%, 500v, dipped silver mica	ElMenco DM-15F-221K-500v
C-0539	270pf, 10%, 500v, dipped silver mica	ElMenco DM-15F-271K-500v
C-0540	330pf, ±10%, 500v, dipped silver mica	ElMenco DM-15F-331K-500v
C-0541	390pf, ±10%, 500v, dipped silver mica	ElMenco DM-15F-391K-500v
C-0542	470pf, ±10%, 300v, dipped silver mica	ElMenco DM-15F-470K-300v
C-0543	1000pf, ±10%, 100v, dipped silver mica	ElMenco DM-15F-102K-100v
C-0544	2000pf, ±10%, 500v, dipped silver mica	Mica Mold MOC-202K
C-0562	.01uf, +80 -20%, 50v ceramic disc	Sprague 19C214
C-0564	.10uf, ±20%, 100v, metalized paper	Electron ME1-104
C-0596	5 pf, 10%, 500v, dipped silver mica	ElMenco DM-15C-050-500v
C-0628	100pf, 10%, 500v, dipped silver mica	ElMenco DM-19F-101K-500v
C-0632	.25 uf, 5%, 100v, mylar	Hopkins P252MC
C-0635	68 pf, ±10%, 500v, dipped silver mica	ElMenco DM-15E-680K-500v
C-0638	680pf, ±10%, 300v, dipped silver mica	Mica Mold MQ-C681K
C-0643	180pf, 10%, 500v, dipped silver mica	ElMenco DM15F-181K-500v
C-0661	0.1uf, ±20%, 10v, ceramic disc	C.R.L. UJ10-104
C-0664	20uf, ±10%, 50v electrolytic	Sprague 40D195A2
C-0672	.05 uf, +80 -20%, 12v, disc	Magnacap R.M.C.
C-0681	820pf, 10%, 300v, dipped silver mica	ElMenco DM-15F-821K-300v
C-0705	.01uf, 10%, 50v, metalized mylar	G.E. 65F10AC103
C-0706		
C-0708	.05uf, +80 -20%, 50v, ceramic disc	Sprague 55C23
C-0709	9 - 35 pf, trimmer	Erie 538-011-E2PO-94R
C-0712	5.5 - 18 pf, trimmer	Erie 538-011-NP05.5-18
C-0732	120 uf, ±20%, 10v	Kenet K120P10
C-0733	.47 uf, 35 - 42v, 20%, tant. solid	G.I. MCSF4-74M
C-0759	3000 pfd, 5%, 500v, dipped silver mica	Arco DM19-302J
C-0760	1500 pf, 5%, 500v, dipped silver mica	Arco DM19-152J
C-0800	1000 uf (each) 50v, double	Sangamo Elec. 505-3802-01
5-13490	1000 uf, 65v	Sprague C-13490
5-13491	33 ufd, 400v	Sprague C-13491

SYS-DON. PART NO.	DESCRIPTION	MANUFACTURER - PART NO.
DIODES		
CR-0064	Type 1N752A, Zener 5.6v	
CR-0072	Type 1N759, 12v, silicon regular	Texas Instruments
CR-0095	Type 1N751A	
CR-0132	Type 1N716, Zener 12v, 1/4w	International Rectifier
CR-0148	Type DI-52	Diodes, Inc. DI-52
CR-0149	Type DI-54, silicon rectifier	Diodes, Inc. DI-54
CR-0150	Type CD 6262, silicon rectifier	Continental Devices
CR-0173	Type 1N3712, tunnel diode	General Electric
CR-0188	Type 1N3719, tunnel diode	General Electric
CR-0189	Type 1N3605, tunnel diode	General Electric
CR-0194	Type Q6-100	International Diode
CR-0224	Type 1N3030A, zener 27v, 5%, 1w	Motorola 1N3030A
CR-0228	Type 1N984B, zener	
6-6700	Type 6700, per S-D Spec.	1N276
FUSE		
F-0019	Fuse, 1.5A Slo Blo	
F-0043	Fuse, 3AG, .25A, Quick Acting	Littlefuse 312-250
INDUCTORS		
L-0053	Choke, 6.8 uh	Essex WEE 6.8
L-0055	Coil, 24v	Coto Coil U-24P
13-15320-1	Inductor, Variable Assembly 1 uh	S-D Corp.
13-15320-2	Inductor, Variable Assembly 3.3 uh	S-D Corp.
TRANSISTORS		
Q-0028	Type 2N697	Fairchild
Q-0073	Type 2N1304	Texas Instruments
Q-0075	Type 2N1306	Texas Instruments
Q-0080	Type 2N1183	RCA
Q-0084	Type 2N1671B	G.E.
Q-0102	Type 2N2270	RCA
Q-0104	Type 2N2142	Motorola
Q-0130	Type 2N706	Philco
Q-0131	Type 2N2201	
Q-0136	3N58 Silicon	G.E.
Q-0157	Type 2N3251	Motorola
Q-0158	Type 2N2708	RCA
Q-0166	Type 40251	RCA
Q-0170	Type 2N1546	Motorola
Q-0171	Type 2N2146	Motorola
Q-0174	Type 2N3251	
Q-6724		
19-6727	Per S-D Spec.	2N1304 equivalent
19-14000	Transistor 14000, per S-D Spec.	2N964 equivalent
19-14092	Transistor 14092, per S-D Spec.	2N709 equivalent
19-15700	Transistor 15700, per S-D spec.	2N404 equivalent
19-15840	Transistor 15840, per S-D Spec.	2N3440 equivalent
19-15850	Transistor 15850, per S-D Spec.	2N3440 equivalent

RESISTORS

SYS-DON. PART NO.	DESCRIPTION
R-0136	3.3K, ±5%, 1/2w
R-0137	56K, ±5%, 1/2w
R-0143	2.7K, ±5%, 1/2w
R-0144	47K, ±5%, 1/2w
R-0150	1M, ±5%, 1/2w
R-0200	7.5K, ±5%, 1/2w
R-0230	43K, ±5%, 1/2w
R-0252	75K, ±5%, 1/2w
R-0259	2.2K, ±5%, 1/2w
R-0260	1.2K, ±5%, 1/2w
R-0263	330K, ±5%, 1/2w
R-0264	220K, ±5%, 1/2w
R-0265	1.5K, ±5%, 1/2w
R-0273	68K, ±5%, 1/23
R-0276	1K, ±5%, 1/2w
R-0277	1.8K, 5%, 1/2w
R-0278	1K, ±5%, 1/2w
R-0292	10K, ±5%, 1/2w
R-0293	120K, ±5%, 1/2w
R-0309	1.2K, 5%, 1/4w
R-0315	330Ω, 5%, 1/2w
R-0321	680Ω, ±5%, 1/2w
R-0330	1K, ±10%, 2s
R-0351	2.5K, ±5%, 1/2w
R-0352	100K, ±5%, 1/2w
R-0354	10Ω, ±5%, 1/2w
R-0355	150K, ±5%, 1/2w
R-0356	100K, ±5%, 1w
R-0365	270Ω, ±5%, 1/2w
R-0424	30Ω, ±5%, 1/2w
R-0431	110Ω, ±5%, 1/2w
R-0466	100Ω, ±5%, 1/2w
R-0472	8.2K, ±5%, 1/2w
R-0474	15K, ±5%, 1/2w
R-0479	91K, ±5%, 1/2w
R-0492	1.2K, ±10%, 1w
R-0514	6.8K, ±5%, 1/2w
R-0522	4.7K, ±5%, 1/2w
R-0527	22K, ±5%, 1/2w
R-0562	5.6K, ±5%, 1/2w

Unless otherwise noted, all resistors are composition carbon by Allen-Bradley.

SYS-DON. PART NO.	DESCRIPTION
R-0564	27K, ±5%, 1/2w
R-0576	67K, ±5%, 1/2w
R-0585	36K, ±5%, 1/2w
R-0616	3.9K, ±5%, 1/2w
R-0619	27K, ±5%, 2w
R-0643	1.8K, ±10%, 1w
R-0662	330Ω, ±5%, 1/4w
R-0670	300Ω, ±5%, 1/4w
R-0677	470Ω, ±5%, 1/2w
R-0694	370Ω, ±5%, 1/4w
R-0695	43K, ±5%, 1/4w
R-0696	6.8K, ±5%, 1/4w
R-0702	4.3K, ±5%, 1/4w
R-0705	36K, ±5%, 1/4w
R-0711	3K, ±5%, 1/4w
R-0715	30K, ±5%, 1/4w
R-0720	3.3K, ±5%, 1/4w
R-0721	2.2K, ±5%, 1/4w
R-0724	39Ω, ±5%, 1/2w
R-0725	180Ω, ±5%, 1/2w
R-0728	15K, ±5%, 1/4w
R-0734	2K, ±5%, 1/4w
R-0736	200Ω, ±5%, 1/4w
R-0739	10Ω, ±5%, 1/4w
R-0741	100K, ±5%, 1/4w
R-0742	3.3K, ±5%, 1/4w
R-0743	47Ω, ±5%, 1/4w
R-0748	39K, ±5%, 1/4w
R-0749	2.2K, ±5%, 1/4w
R-0759	12K, ±5%, 1/4w
R-0760	220Ω, ±5%, 1/4w
R-0762	820Ω, ±5%, 1/4w
R-0765	1K, ±5%, 1/4w
R-0766	10K, ±5%, 1/4w
R-0768	22K, ±5%, 1/43
R-0776	9.1K, ±5%, 1/43
R-0777	47K, ±5%, 1/4w
R-0780	33K, ±5%, 1/4w
R-0783	1.5K, ±5%, 1/4w
R-0784	82K, ±5%, 1/4w
R-1287	Pot. 2w EZ Trip
R-1288	Trimpot, 1K, 1/2w, ±10%
R-1317	Pot. 500Ω, 1/2w, w.w. EZ trim
R-1498	100K, ±2%, 1/2w, metal film
R-1499	120K, ±2%, 1/2w, metal film
R-1596	22K, ±2%, 1w
R-1661	2Ω, 2w, wire wound
R-1665	Pot. 5K, ±30%, 1/4w

SYS-DON. PART NO.	DESCRIPTION
R-0785	18K, ±5%, 1/4w
R-0807	120K, ±5%, 1/4w
R-0809	1.2K, ±5%, 1/4w
R-0819	560Ω, ±5%, 1/4w
R-0821	5.6K, ±5%, 1/4w
R-0823	200K, ±5%, 1/4w
R-0824	27K, ±5%, 1/4w
R-0835	240Ω, ±5%, 1/4w
R-0875	100K, ±5%, 1/4w
R-0879	10K, ±5%, 1w
R-0880	390Ω, ±5%, 1/4w
R-0883	8.2K, ±5%, 1/4w
R-0884	7.5K, ±5%, 1/4w
R-0892	4.7K, ±5%, 1/4w
R-0937	2.7K, ±5%, 1/4w
R-0939	3.9K, ±5%, 1/4w
R-0962	1M, ±5%, 1/4w
R-0965	6.2K, ±5%, 1/4w
R-0966	100Ω, ±5%, 1/4w
R-0971	62K, ±5%, 1/4w
R-0976	75K, ±5%, 1/4w
R-0983	150Ω, ±5%, 1/4w
R-0984	510Ω, ±5%, 1/4w
R-1044	470Ω, ±5%, 1/4w
R-1059	82Ω, ±5%, 1/4w
R-1083	560Ω, ±5%, 1/2w
R-1113	10K, ±10%, 2w
R-1116	47K, ±5%, 2w
R-1233	180Ω, 1/4w, 5%
R-1234	680Ω, ±5%, 1/4w
R-1235	56K, ±5%, 1/4w
R-1246	51Ω, ±5%, 1/4w
R-1295	240Ω, ±5%, 2w
R-1313	30Ω
R-1425	750Ω, ±5%, 1/4w
R-1436	
R-1549	30Ω, ±5%, 1/4w
R-1556	75Ω, ±5%, 1/4w
R-1571	360Ω, ±5%, 1/4w
R-1573	1K, ±5%, 2w
R-1589	36K, ±5%, 2w
R-1590	620Ω, ±5%, 1w
R-1593	
R-1667	430Ω, ±5%, 1/4w
R-1668	560Ω, ±5%, 1w
R-1669	1.1K, ±5%, 1w
R-1701	3K, ±5%, 1/2w
R-1868	270Ω, ±5%, 3w
R-1089	1K, ±5%, 1w

TRANSFORMERS

		Manufacturer
T-0083		
T-0084	1:1 T801	
T-0085	6:1 T802	
1-13516	Insulation, Trans.	S-D Corp.
9-15326	Foil, Trans.	S-D Corp.
23-12740	Transformer	Tranex 23-12740

Part No.	Description	Ref.
15452	FINAL ASSEMBLY	
15439	Panel, Front, Assembly	
15440	Panel, Front S.S. Assy	
15962	Time Base-Function Sw. Cable Assy	
15963	Time Base Sw. Jumper & Loose Wire Assembly	
15961	Wire Prep. Assy	
15964	Function Sw. Jumper & Loose Wire Assy	
17004	Wire Prep. Assy	
17002	Mother Bd #1 PC Bd Assy	
16155	Loose Wire Prep. Assy	
15459	Annunciator Assy	
15718	Range Sw. Level Control Cable Assy	
15455	Rear Panel Assy	
15448	Power Supply Assy	
15965	Connector J1 Cable Assy	
15966	Wire Prep. Assy	
15412	Power Supply PC Bd Assy	
15458	Mother Bd #2 PC Bd Assy	
15394	Chassis Assembly	
16152	Connector J7 Cable Assy	
16151	Wire Prep. Assy	
10504	250KC Stand. Decade PC Bd Assy	
13269	2.5MC Stand. Decade PC Bd Assy	
15116	10MC Stand. Decade PC Bd Assy	
12242	50MC Readout Decade PC Bd Assy	
15391	Display & Reset PC Bd Assy	
11095	Multiplier & Osc. PC Bd Assy	
13534	50MC Amplifier PC Bd Assy	
15422	Time Base PC Bd Assy	
11523	250KC Storage Decade PC Bd Assy	
11527	2.5MC Storage Decade PC Bd Assy	
15200	10MC Storage Decade PC Bd Assy	
12970	50MC Readout Decade PC Bd Assy	
12983	Multiply + 3 PC Bd Assy	
12970	Power Supply PC Bd Assy	
15439	FRONT PANEL ASSEMBLY	
15440	Panel, Front, S.S. Assy	
15581	Art Work	
15415	Panel Front	
17007	Panel, Front Blank	
15962	Time Base-Function Sw. Cable Assy	
15963	Time Base Sw. Jumper & Loose Wire Assy	
15213	Time Base Sw	S1
15961	Wire Prep. Assy	
16141	Wire PVC, per Std Wire List	
15964	Function Sw. Jumper & Loose Wire Assy	
15214	Function Switch	S2
17004	Wire Prep. Assy	
16141	Wire #22 PVC per Std. Wire, Coax RG-196/U	
H-0955	Ferrule	
TS-0024	Thermal Sleeving	
H1104	Cable Tie	
16155	Loose Wire Prep. Assy	
15459	Annunciator Assy	
15718	Range Sw-Level Control Cable	
E-0137	Lug, Ground, BNC Type	
11342	Lock, Panel	
13548	Knob, Black, 1/4" dia. shaft	
13547	Knob, Black, 1/8" dia. shaft	
J-0260	Connector, BNC	J2
S-0073	Switch, Toggle, DPDT	S7
S-0140	Switch, Pushbutton SPST	S8
11637	Knob Spec. Dual Control	
11636	Knob Spec. Single Shaft	
15404	Bracket, Window	
11066	Window	
15405	Bracket, PC Mtg.	
I-0055	Lamp, Pilot w/33K 1/4w Res. amber	I1
I-0047	Lamp, Pilot 3/150K 1/2w Res. Red	I2
H-1271	Screw, Tapping #2x1/4" Type B	
H-0988	Screw, Flat Hd. 6-32x1/2 Ph NPS	
H-1282	Washer, Lock #4 Int Tooth CPS	
H-1273	Screw Pan Hd 4-40x5/16 Ph CPS	
H-0984	Screw Pan Hd 6-32x3/8 Ph CPS	
H-0410	Washer, Lock #6 Int. Tooth CPS	

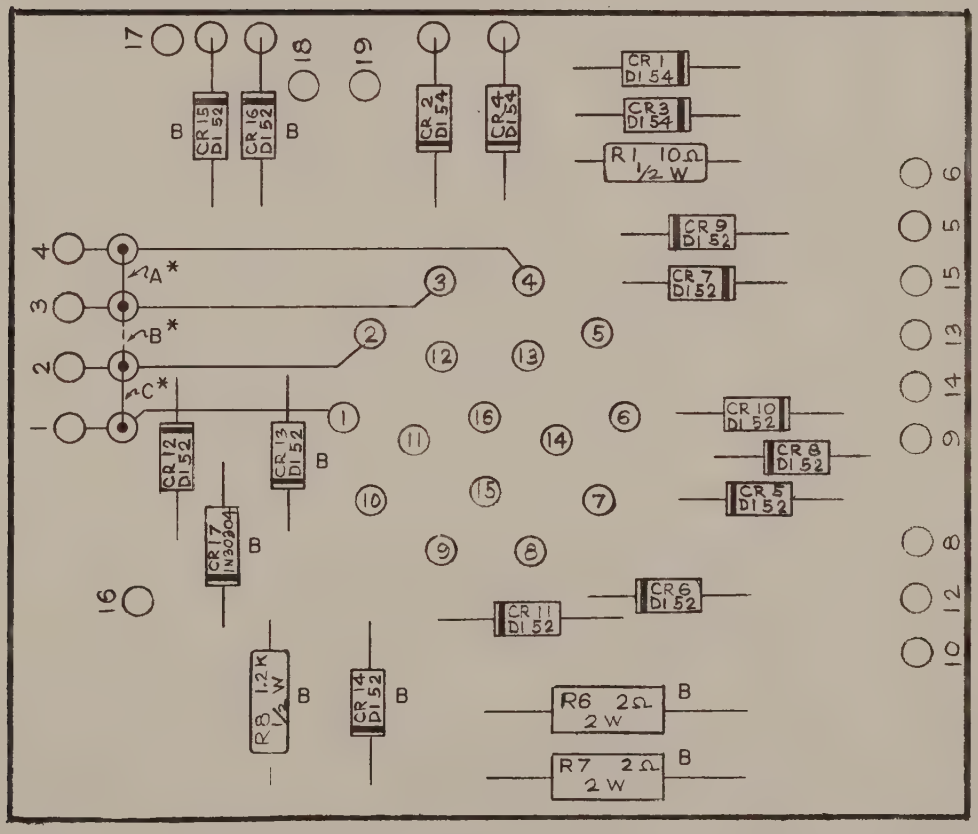
Part No.	Description	Ref.
17002	MOTHER BOARD NO. 1 PC ASS'Y	
16160	Mother Bd #1 PC Board	
17000	Artwork Mother Bd #1	
16046	Insulator, Socket	
X-0078	Socket, 9 Contacts	
J-0262	Connector, 20 Contacts	
13550	Connector, 12 Contacts	
10052	Indicator	I8
		I9
		I10
		I11
	Same as I8	I12
15455	REAR PANEL ASSEMBLY	
15658	Panel, Rear SS Assy	
12876	Artwork	
15456	Panel, Rear Welding Assy	
15457	Panel, Rear	
H-0390	Weld Nut 4-40	
H-03969	Weld Nut 6-32	
11115	Screen	
11096	Plug Plate	
15681	Fan Guard Assy	
15679	Cover, Fan Guard	
15680	Screen, Fan Guard	
15711	Fan Motor & Blade Assy	B1
B-0013-1	Fan Motor	
B-0013-2	Fan Blade	
B-0013-3	Screw 3-48	
15969	Rear Panel Cable Assy	
15970	Wire Prep. Assy	
	Wire Belden 8451 2 Cond.	
	Wire, Coas R6-196/U	
	Wire, 22 Ga PVC per wire std. 16141	
40955	Ferrule	
TS-0024	Thermal Sleeving	
H-1104	Cable Tie	
W-0004	Cord, AC Line	
X-0034	Holder, Fuse	
J-0260	Connector, BNC	J3
S-0110	Switch Slide, DPDT	S4
	Same as Se	S6
E-0137	Lug Ground, BNC Type	
H-0383	Heyco Nut	
H-0404	Rivet 1/8 dia 1/8 long	
H-0819	Screw, Pan Hd. 4-40x3/4 NPS	
H-1049	Screw, Pan Hd. 6-32x1/2 NPS	
H-0657	Screw, Pan Hd. 4-40x5/16 NPS	
H-0410	Washer, Lock #6 Int. tooth CPS	
H-0248	Washer, Lock #4 Int. tooth NPS	
15458	MOTHER BOARD NO. 2 P.C. ASS'Y	
16159	Mother Bd #2 PC Board	
17001	Artwork	
X-0103	Socket Octal	
J-0228	Connector, 22 Contacts	
J-0272	Connector, 15 Contacts	
E-0191	Terminal (18 Ga Wire)	
C-0424	Capacitor, .001 mfd 500v Disc	C1
C-0441	Capacitor, .01 mfd	C8

SYS-DON PART NO.	DESCRIPTION	MANUFACTURER - PART NO.
MISCELLANEOUS		
E-0100	Terminal, Space Lug P.C.	USECO
E-0112	Solder Lug #8, Int. Tooth	
E-0146		
E-0184	Coil Forms with Adj. Core	Delevan Elec. DEL 6/C
H-0146	Transistor Pad Coupling, Solid	Pacific Wholesale
H-0376	Screw, 4-40x3/8"Cad. Plt'd BHMS	
H-0377		
H-0393		
H-0481		
H-0515	Transistor Mtg Pad	Delbert Blinn TP 501
H-0516	Screw, Mach. 6-32x1-1/2" CPS	
H-0606	Grommet 1/2" dia mtg	Rubbercraft
H-0658	Washer, Int. Tooth #8, .33 OD nom. x1/64"	
H-0726		
H-0727		
H-0746	Washer, Lock, Int. tooth #6 CPS	
H-0749	Nut, 6-32 lug, Pattern C.P.S.	
H-0791		
H-0940	Drive Rivets, Aluminum S.S. Pins	Southco 38-104-06-13
H-0941	Nylon Bushing 6x1/4" length	Machine Part Co., N.Y.
H-0980		
H-1033	Screw, 8-32x3/8, C.P.S., Phillip hd	
H-1055	Thermal Compound	Wakefield 122
H-1104		
H-1155	Washer, Shldr 5/16", Fiber #6	G.C. #6525C
H-1182		
H-1275		
I-0041	Lamp	
J-0170	Connector 50 pin (See P/L 17013)	
S-0132	Reed Relay Contacts, N.O., Magnetic Reed	Gordos Corp MR400-1
X-0127	Fuse Holder for 3AG fuses, 5 pole	Littlefuse 357005
9669	PC Bd. Stiffener	
11529	PC Bd (10MC)	
12241	50MC Readout Bd.	
13269		
14599-1		
14899-1		
15200	10MC Storage Decade Assy	
15371	SS Assy	
15674	1-2-4-8 Option Bd	

Rectifier Board Composite Parts List

CAPACITORS		DIODES		TRANSISTORS		TRANSFORMER	RESISTORS
Schem. Ref	S-D Part No.	S-D Part No.	Schem Ref.	Schem. Ref	S-D Part No.	T1 1-13516 A/W 15047 9-15326	Schem Ref.
C1	5-13491	CR5	CR-0148	Q1	Q-0171		R1
C2	5-13490	CR6	CR-0148	Q2	Q-0170	P. C. BD. RECTIFIER ASSY.	R2
C3	C-0800	CR7	CR-0148	Q3	Q-0166	2-15414	R3
C4	5-13490	CR8	CR-0148	Q4	Q-0104		R4
C5	5-13490	CR9	CR-0148	Q5	Q-0170		R5
		CR10	CR-0148	Q6	Q-0166	P. C. BD. RECTIFIER	R6**
DIODES		CR11	CR-0148				R7**
Schem. Ref.	S-D Part No.	CR12	CR-0148	FUSES		A/W 15399 29-15400	R8**
CR1	CR-0149	CR13	CR-0148				R19
CR2	CR-0149	CR14**	CR-0148	F1	F-0043		R20
CR3	CR-0149	CR15**	CR-0148	F2	F-0001		R21
CR4	CR-0149	CR16**	CR-0148	F3	F-0001		R22
		CR17	CR-0224	F4	F-0001		R23
				F5	F-0001		R24

**Components marked B and B3 are on B and B3 option boards only.



* Remove jumpers A and C and install jumper B for 230V conversion (See paragraph 2-9)

Rectifier Board Parts Location Detail, No. 15401

Schem Ref.	Illus Index	S-D Part
CAPACITORS		
C101	B3	C-0542
C104	B1	C-0708
C105	B4	C-0664
C106	B5	C-0732
C107	A5	C-0732^{S} C0228^{N}
C109	B2	C-0708
C110	B4	C-0664
C114	B4	C-0708
C115	B4	C-0708
C116	C1	C-0564
C117	B1	C-0325
C118	B1	C-0325
C119	C2	C-0564
C126	A6	C-0759^{S}
S C127	A6	C-0760^{S}
C128	A6	C-0441^{S}
C129	B4	C-0544
C130	B5	C-0632
C131	C3	C-0417
DIODES		
CR101	C4	CR-0132
CR102	B1	CR-0132
CR103	B3	CR-0064
CR104	B3	CR-0095
CR105	B2	CR-0132
CR106	C4	6-6700^{N}
CR107	C5	6-6700
CR108	C4	6-6700
CR109	C4	6-6700
S CR110	B6	6-6700 S
CR111	B6	6-6700
CR112	C5	6-6700
CR113	B3	CR-0228
TRANSISTORS		
Q101	B3	Q-0157
Q102	B1	19-15700
Q103	B1	Q-0080
Q104	B3	Q-0080
Q105	B3	Q-0102
Q106	B2	19-15700
Q107	B2	Q-0080
Q108^{N}	B5	15840^{N}
Q109^{N}	C5	6724^{N}
Q110	C5	19-15840
Q111	B6	19-15840
S Q112	B6	19-15840
Q113	B5	Q-0084 S
Q114	B6	Q-0102

Schem Ref.	Illus Index	S-D Part
RESISTORS		
R101	C3	1589
R102	A3	1297
R103	A3	0136
R104	B4	0725
R105	A4	0365
R107	A1	0562
R108	A1	0562
R109	A1	0466
R110	A1	0143
R111	A1	0259
R112	A1	1287
R113	A1	0616
R115	A4	0143
R116	A3	1863
R118	A5	1083
R120	A3	1317
R121	A3	0136
R122	A3	1083
R124	A5	1083
R126	A2	0562
R127	A2	0562
R128	A2	0466
R129	A2	0143
R130	A2	0259
R131	A2	1287
R132	A2	0616
R133	C5	0514
R134	C5	0514
R135	C5	0278
N R136	B5	0472
R137	B6	1116^{N}
R138	A6	0293
R139	A6	0352
R140	A6	0292

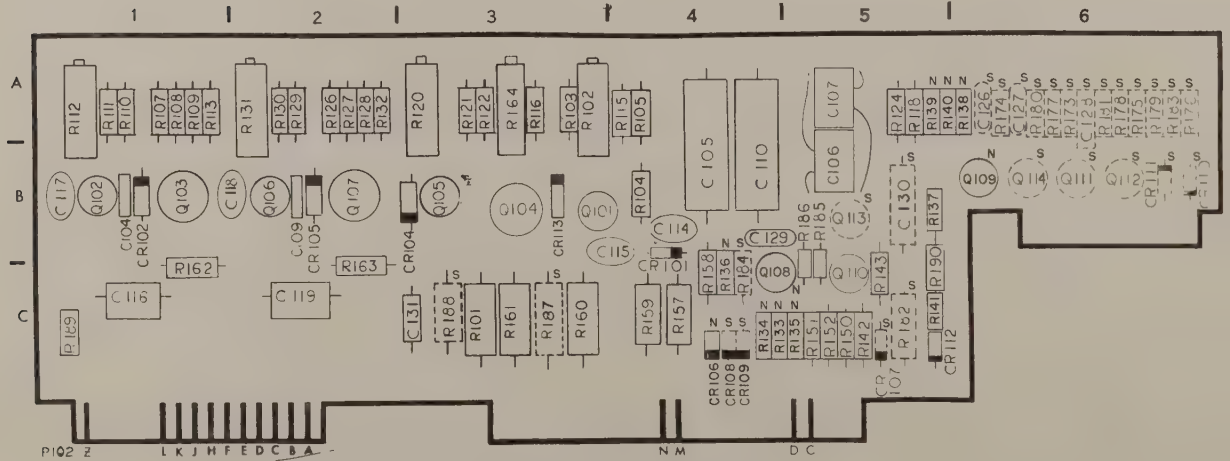
Schem Ref.	Illus Index	S-D Part
R141^{N}	C6	1573
R142	C5	0562
R143	C5	0144
R150	C5	0293
R151	C5	0230
R152	C5	0355
R157	C4	1590
R158	C4	0616
R159	C4	1669
R160	C3	1295
R161	C3	0619
R162	C1	0562
R163	C2	0562
R164	A3	1317
R173	A6	0292
R174	A6	0564
R175	A6	0143
R176	A6	0137
R177	A6	1315
R178	A6	0315
R179	A6	0315
R180	A6	1564
R181	A6	1527^{S}
S R182	C5	0643
R183	A6	0273
R184	C4	0278
R185	B5	0983
R186	B5	0741
R187	C3	0619
R188	C3	0356
R189	C1	0724
R190	B5	0564

MISCELLANEOUS

Schem Ref.	S-D Part	
P.C. Bd. P.S. Ass'y	2-12970^{S}	15412^{N}
P.C. Bd. P.S.	29-15411	
P.C. Bd., Stiffener Silk Screen assy	2-15329^{S}	15424^{N}
P.C. Bd. Stiffener	1-9669	

*Use with Dwg. 15413

NOTES:*
1–Components not marked N or S are on all boards regardless of option:
2–Components marked N are on non-storage option boards only:
3–Components marked S are on storage option boards only:
4–Rectifier board components are shown in Figure 11-8:
5–Refer to Master Parts List (Section 13) for component descriptions



Power Supply Composite Parts Location Detail
(Standard, 15413, Storage 12970)

Standard Oscillator and Amplifier Parts List

CAPACITORS

Ref.No.	Index	S-D Part No.
C801	A A1	C-0643
C802	A1	C-0709
C802	B1	C-0706
C803	B1	C-0706
C804	B1	C-0705
C805	B1	C-0708
C806	B1	C-0708
C807	B1	C-0708
C808	C5	C-0708
C809	A5	C-
C810	A6	C-0681
C811	B6	C-0681
C812	A6	C-0681
C813	A6	C-0681
C814	A6	C-0542

DIODES

Ref.No.	Index	S-D Part No.
CR801	A7	6-6700
CR802	A5	CR-0150
CR803	A5	CR-0150
CR804	B6	

INDICATORS

Ref.No.	Index	S-D Part No.
I801	A1	I-0041
I802	C1	

TRANSISTORS

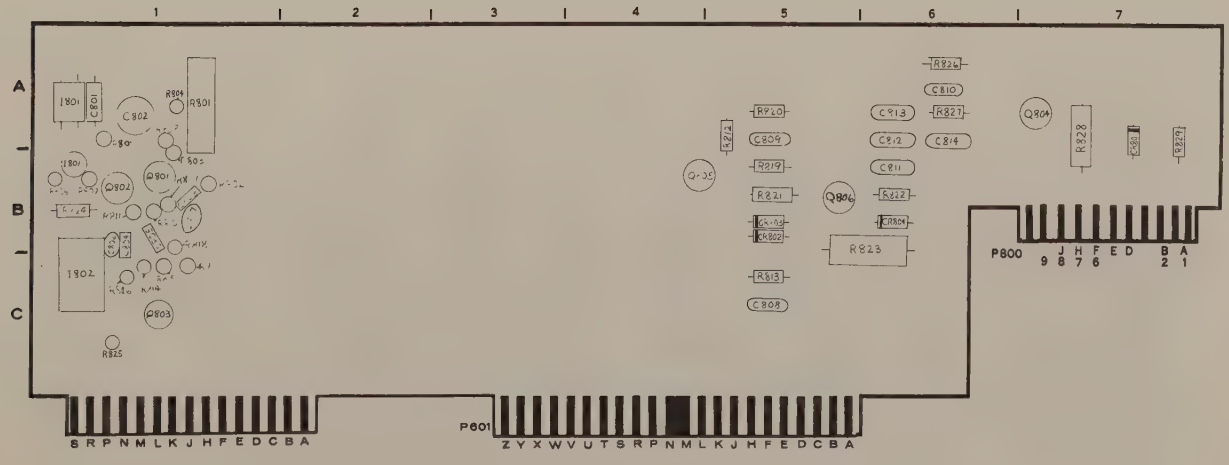
Ref.No.	Index	S-D Part No.
Q801	B1	14000
Q802	B1	14000
Q803	C1	0087
Q804	A7	14000
Q805	B4	14000
Q806	B5	14000

TRANSFORMERS

Ref.No.	Index	S-D Part No.
T801	B1	T-0084

RESISTORS

Ref.No.	Index	S-D Part No.
R801	A1	R-1288
R802	B1	R-0662
R803	B1	R-0749
R804	A1	R-0749
R805	A1	R-1313
R806	B1	R-0742
R807	B1	R-0742
R8088	A1	R-0765
R809	B1	R-0742
R810	B1	R-0277
R811	B1	R-0819
R812	A5	R-0760
R813	C5	R-0749
R814	C1	R-0743
R815	C1	R-0742
R816	C1	R-0742
R817	C1	R-1234
R818	B1	R-0892
R819	B5	R-0728
R820	A5	R-0696
R821	B5	R-0467
R822	B6	R-0696
R823	B5	R-0892
R824	B1	R-0967
R825	C1	R-0696
R826	A6	R-1436
R827	A6	R-1549
R828	A7	R-1235
R829	A7	R-0635



Standard Oscillator Amplifier Parts Location Detail, Assy. 17214

CAPACITORS

Schem. Ref.	Illus. Index	S-D Part
C1	A5	C-0533
C2	A5	C-0533
C3	B5	C-0533
C4	B5	C-0533
C5	C5	C-0533
C6	C5	C-0533
C7	D5	C-0529
C8	D5	C-0529
C9	B5	C-0529
C10	B5	C-0529
C11	C5	C-0531
C12	C5	C-0529
C13	A5	C-05[illegible]
C14	D4	C-0539
C15	D4	C-0539
C16	D4	C-0539
C17	C4	C-0539
C18	C4	C-0539
C19	B4	C-0539
C20	B4	C-0539
C21	A4	C-0539
C22	A4	C-0539
C23	C4	C-0537
C24	B4	C-0537
C25	B4	C-0537
C26	C6	C-0537
C27	B6	C-0536
C28	B6	C-0533
C29	B6	C-0537
C30	B6	C-0533
C31	D5	C-0562
C32	A6	C-0708
C33		C-0537
C34		C-0537
C35		C-0537
C15-2	A3	C-0539
C16-2	B3	C-0539
C17-2	B3	C-0539
C18-2	B3	C-0539
C19-2	C3	C-0539
C20-2	C3	C-0539
C21-2	D3	C-0539
C22-2	D3	C-0539
C23-2	B3	C-0537
C24-2	B3	C-0537
C25-2	C3	C-0537
C26-2	C3	C-0537
C15-3	D2	C-0539
C16-3	D2	C-0539
C17-3	C2	C-0539
C18-3	C2	C-0539
C19-3	B2	C-0539
C20-3	B2	C-0539
C21-3	A2	C-0539
C22-3	A2	C-0539
C23-3	C2	C-0537
C24-3	B2	C-0537
C25-3	B2	C-0537
C26-3	C2	C-0537
C15-4	A1	C-0539
C16-4	B1	C-0539
C17-4	B1	C-0539
C18-4	B1	C-0539
C19-4	C1	C-0539
C20-4	C1	C-0539
C21-4	D1	C-0539
C22-4	D1	C-0539
C23-4	B1	C-0537
C24-4	B1	C-0537
C25-4	C1	C-0537
C26-4	C1	C-0537

DIODES

Schem. Ref.	Illus. Index	S-D Part
CR1	B5	CR-0150
CR2	A5	CR-0150
CR3	A5	CR-0150
CR4	A5	6700
CR5	B5	CR-0150
CR6	C5	CR-0150
CR7	B5	6700
CR8	B5	6700
CR9	C5	CR-0150
CR11	C5	6700
CR12	C5	6700
CR13	C5	6700
CR22	C4	CR-0150
CR23	D4	6700
CR24	D4	6700
CR25	C4	CR-0150
CR26	C4	6700
CR27	C4	6700
CR28	B4	6700
CR29	B4	6700
CR30	B4	6700
CR31	A6	6700
CR22-2	B2	CR-0150
CR23-2	A2	6700
CR24-2	A1	6700
CR25-2	B3	CR-0150
CR26-2	B3	6700
CR27-2	B3	6700
CR28-2	C3	6700
CR29-2	C3	6700
CR30-2	D3	6700
CR22-4	B1	CR-0150
CR23-4	A1	6700
CR24-4	A1	6700
CR25-4	B1	CR-0150
CR26-4	B1	6700
CR27-4	B1	6700
CR28-4	C1	6700
CR29-4	C1	6700
CR30-4	D1	6700

TRANSISTORS

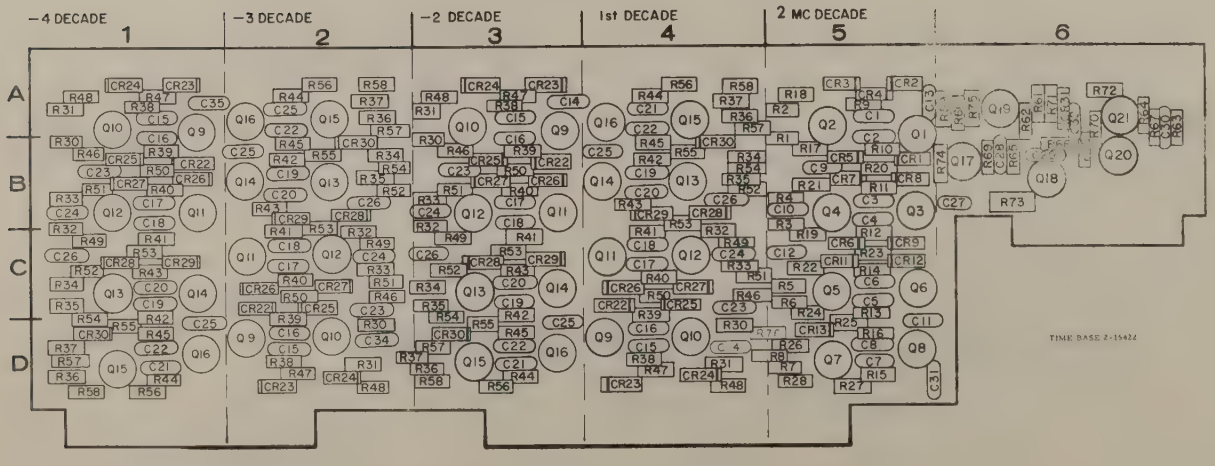
Schem. Ref.	Illus. Index	S-D Part
Q1	A5	14000
Q2	A5	14000
Q3	B5	14000
Q4	B5	14000
Q5	C5	14000
Q6	C5	14000
Q7	D5	14000
Q8	D5	14000
Q9	D4	15700
Q10	D4	15700
Q11	C4	15700
Q12	C4	15700
Q13	B4	15700
Q14	B4	15700
Q15	A4	15700
Q16	A4	15700
Q17	B6	14000
Q18	B6	14000
Q19	A6	14000
Q20	B6	14000
Q21	A6	14000
Q9-2	A3	15700
Q10-2	A3	15700
Q11-2	B3	15700
Q12-2	B3	15700
Q13-2	C3	15700
Q14-2	C3	15700
Q15-2	D3	15700
Q16-2	D3	15700
Q9-3	D2	15700
Q10-3	D2	15700
Q11-3	C2	15700
Q12-3	C2	15700
Q13-3	B2	15700
Q14-3	B2	15700
Q15-3	A2	15700
Q9-4	A1	15700
Q10-4	A1	15700
Q11-4	B1	15700
Q12-4	B1	15700
Q13-4	C1	15700
Q14-4	C1	15700
Q15-4	D1	15700
Q16-4	D1	15700

RESISTORS

Schem. Ref.	Illus. Index	S-D Part
R1	A5	R-0783
R2	A5	R-0783
R3	B5	R-0783
R4	B5	R-0783
R5	C5	R-0783
R6	C5	R-0783
R7	D5	R-0783
R8	D5	R-0783
R9	A5	R-0883
R10	B5	R-0883
R11	B5	R-0883
R12	B5	R-0883
R13	C5	R-0883
R14	C5	R-0883
R15	D5	R-0883
R16	D5	R-0883
R17	B5	R-0784
R18	A5	R-0784
R19	B5	R-0784
R20	B5	R-0784
R21	B4	R-0784
R22	C	R-0784
R23	C5	R-0784
R24	C5	R-0784
R25	C5	R-0784
R26	D5	R-0784
R27	D5	R-0784
R28	D5	R-0784
R30	D4	R-0742
R31	D4	R-0742
R32	C4	R-0742
R33	C4	R-0742
R34	B4	R-0742
R35	B4	R-0742
R36	A4	R-0783
R37	A4	R-0783
R38	D2	R-0759
R39	C2	R-0759
R40	C2	R-0759
R41	C2	R-0759
R42	B2	R-0759
R43	B2	R-0759
R44	A2	R-0759
R45	B4	R-0759
R46	C4	R-0784
R47	D4	R-0783
R48	D4	R-0784
R49	C4	R-0784
R50	C4	R-0783
R51	C4	R-0784
R52	B4	R-0784
R53	B4	R-0783
R54	B4	R-0784
R55	B4	R-0783
R56	A4	R-0784
R57	B4	R-0784
R58	A4	R-0784
R59	A6	R-0821
R60	A6	R-0765
R61	A6	R-0785
R62	A6	R-0762
R63	A6	R-0762
R64	A6	R-0762
R65	B6	R-0892
R66	B6	R-0937
R67	A6	R-0883
R68	B6	R-0824
R69	B6	R-0309
R70	A6	R-0309
R71	A6	R-0966
R72	A6	R-0784
R73	B6	R-0939
R74	B6	R-0765
R75	A6	R-0742
R76	D5	R-0966
R30-2	B3	R-0742
R31-2	A3	R-0742
R32-2	B3	R-0742
R33-2	B3	R-0742
R34-2	C3	R-0742
R35-2	C3	R-0742
R36-2	D3	R-0783
R37-2	D3	R-0783
R38-2	D3	R-0759
R39-2	B3	R-0759
R40-2	B3	R-0759
R41-2	C3	R-0759
R42-2	C3	R-0759
R43-2	C3	R-0759
R44-2	D3	R-0759
R45-2	D3	R-0759
R46-2	B3	R-0784
R47-2	A3	R-0793
R48-2	A3	R-0794
R49-2	C3	R-0794
R50-2	B3	R-0783
R51-2	B3	R-0784
R52-2	C3	R-0784
R53-2	C3	R-0783
R54-2	C3	R-0784
R55-2	D3	R-0783
R56-2	D3	R-0783
R57-2	D3	R-0784
R58-2	D3	R-0784
R30-3	D2	R-0742
R31-3	D2	R-0742
R32-3	C2	R-0742
R33-3	C2	R-0742
R34-3	B2	R-0742
R35-3	B2	R-0742
R36-3	A2	R-0783
R36-3	A2	R-0783
R38-3	D2	R-0759
R39-3	C2	R-0759
R40-3	C2	R-0759
R41-3	C2	R-0759
R42-3	B2	R-0759
R43-3	B2	R-0759
R44-3	A2	R-0759
R45-3	B2	R-0759
R46-3	C2	R-0784
R47-3	D2	R-0783
R48-3	D2	R-0784
R49-3	C2	R-0784
R50-3	C2	R-0783
R51-3	C2	R-0784
R52-3	B2	R-0784
R53-3	B2	R-0783
R54-3	B2	R-0784
R55-3	B2	R-0783
R56-3	D2	R-0783
R57-3	B2	R-0784
R58-3	A2	R-0784
R30-4	B1	R-0742
R31-4	A1	R-0742
R32-4	B1	R-0742
R33-4	B1	R-0742
R34-4	C1	R-0742
R35-4	C1	R-0742
R36-4	D1	R-0783
R37-4	D1	R-0783
R38-4	A1	R-0759
R39-4	B1	R-0759
R40-4	B1	R-0759
R41-4	C1	R-0759
R42-4	C1	R-0759
R43-4	C1	R-0759
R44-4	D1	R-0759
R45-4	D1	R-0759
R46-4	B1	R-0784
R47-4	A1	R-0783
R48-4	A1	R-0784
R49-4	C1	R-0783
R50-4	B1	R-0784
R51-4	B1	R-0784
R52-4	C1	R-0784
R53-4	C1	R-0783
R54-4	C1	R-0784
R55-4	D1	R-0783
R56-4	D1	R-0783
R57-4	D1	R-0784
R58-4	D1	R-0784

MISCELLANEOUS

P.C. Board	15190
P.C. Board Stiffener S.S. Assy.	15477
P.C. Board Stiffener	9669
Nylon Bushing	H-0941
Drive Rivet #38-104-06-13	H-0940



Time Base Divider Parts Location Detail, Assy. 15422

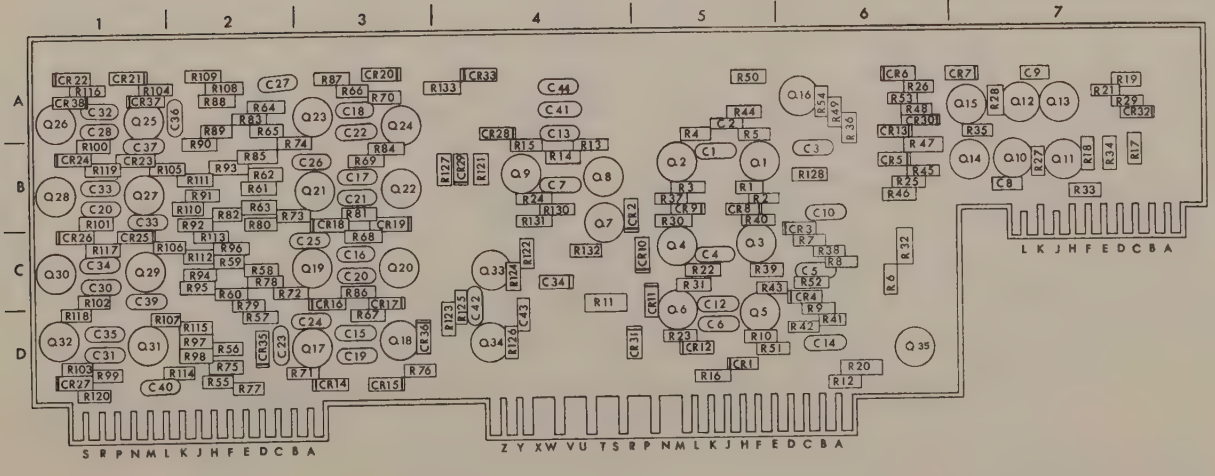
Schem. Ref.	Illus. Index	S-D Part
CAPACITORS		
C1	B5	C-0628
C2	A5	C-0733
C3	B6	C-0628
C4	C5	C-0530
C5	C6	C-0533
C6	D5	C-0530
C7	B4	C-0628
C8	B7	C-0406
C9	A7	C-0524
C10	B6	C-0531
C12	C5	C-0628
C13	A4	C-0354
C14	D6	C-0531
C15	D3	C-0535
C16	C3	C-0533
C17	B3	C-0533
C18	A3	C-0529
C19	D3	C-0535
C20	C3	C-0533
C21	B3	C-0533
C22	A3	C-0529
C23	D2	C-0531
C24	D3	C-0529
C25	C3	C-0529
C26	B3	C-0531
C27	A2	C-0529
C28	A1	C-0539
C29	B1	C-0539
C30	C1	C-0539
C31	D1	C-0539
C32	A1	C-0539
C33	B1	C-0539
C34	C1	C-0539
C35	D1	C-0539
C36	A2	C-0537
C37	B1	C-0537
C38	B1	C-0537
C39	C1	C-0537
C40	D1	C-0538
C41	A4	C-0235
C42	C4	C-0628
C43	D4	C-0733
C44	A4	C-0235

Schem. Ref.	Illus. Index	S-D Part
DIODES		
CR1	D5	CR-0150
CR2	B5	CR-0150
CR3	C6	CR-0150
CR4	C6	CR-0150
CR5	B6	CR-0150
CR6	A6	CR-0150
CR7	A7	CR-0150
CR8	B5	CR-0150
CR9	B5	CR-0150
CR10	C5	CR-0150
CR11	C5	CR-0150
CR12	D5	CR-0150
CR13	A6	CR-0150
CR14	D3	CR-0150
CR15	D3	CR-0150
CR16	C3	CR-0150
CR17	C3	CR-0150
CR18	B3	CR-0150
CR19	B3	CR-0150
CR20	A3	CR-0150
CR21	A1	6-6700
CR22	A1	6-6700
CR23	B1	6-6700
CR24	B1	6-6700
CR25	C1	6-6700
CR26	C1	6-6700
CR27	D1	6-6700
CR28	A4	CR-0150
CR29	B4	CR-0150
CR30	A6	6-6700
CR31	D5	CR-0150
CR32	A7	CR-0150
CR33	A4	CR-0150
CR34	B4	6-6700
CR35	D2	CR-0150
CR36	D3	CR-0150
CR37	A1	6-6700
CR38	A1	6-6700

Schem. Ref.	Illus. Index	S-D Part
TRANSISTORS		
Q1	B5	15700
Q2	B5	15700
Q3	C5	14000
Q4	C5	14000
Q5	D5	14000
Q6	D5	14000
Q7	B5	6727
Q8	B5	15700
Q9	B4	15700
Q10	B7	Q-0028
Q11	B7	Q-0084
Q12	A7	15700
Q13	A7	15700
Q14	B7	6727
Q15	A7	15700
Q16	A6	Q-0130
Q17	D3	14000
Q18	D3	14000
Q19	C3	14000
Q20	C3	14000
Q21	B3	14000
Q22	B3	14000
Q23	A3	14000
Q24	A3	14000
Q25	A1	15700
Q26	A1	15700
Q27	B1	15700
Q28	B1	15700
Q29	C1	15700
Q30	C1	15700
Q31	D1	15700
Q32	D1	15700
Q33	C4	15700
Q34	D4	15700
Q35	D6	15700

Schem. Ref.	Illus. Index	S-D Part
RESISTORS		
R1	B5	R-1234
R2	B5	R-0768
R3	B5	R-1234
R4	A5	R-0821
R5	A5	R-0768
R6	C6	R-0777
R7	C6	R-0880
R8	C6	R-0880
R9	D6	R-0880
R10	D5	R-0765
R11	C5	R-0143
R12	D6	R-0696
R13	B5	R-1234
R14	B4	R-0768
R15	B4	R-1234
R16	D5	R-0814
R17	B7	R-0766
R18	B7	R-0662
R19	A7	R-0766
R20	D6	R-0259
R21	A7	R-0819
R22	C5	R-0821
R23	D5	R-0821
R24	B4	R-0821
R25	B6	R-0821
R26	A6	R-0766
R27	B7	R-0739
R28	A7	R-0765
R29	A7	R-0721
R30	B5	R-0821
R31	C5	R-0821
R32	C6	R-0136
R33	B7	R-0966
R34	B7	R-0783
R35	A7	R-0821
R36	A6	R-0768
R37	B5	R-0783
R38	C6	R-0696
R39	C5	R-0768
R40	B5	R-0768
R41	D6	R-0696
R42	D6	R-0768
R43	C5	R-0768
R44	A5	R-0780
R45	B6	R-0768
R46	B6	R-0720
R47	B6	R-0136
R48	A6	R-0720
R49	A6	R-0783
R50	A5	R-0883
R51	D5	R-0783
R52	C6	R-0966
R53	A6	R-0765
R54	A6	R-728
R55	D2	R-0696
R56	D2	R-0783
R57	D2	R-0783
R58	C2	R-0783
R59	C2	R-0783
R60	C2	R-0696
R61	B2	R-0783
R62	B2	R-0783
R63	B2	R-0696
R64	A2	R-0696
A65	A2	R-0783
R66	A3	R-0783
R67	D3	R-0883
R68	C3	R-0883
R69	B3	R-0883
R70	A3	R-0883
R71	D3	R-0883
R72	C2	R-0883
R73	B2	R-0883
R74	B2	R-0883
R75	D2	R-0784
R76	D3	R-0783
R77	D2	R-0784
R78	C2	R-0784
R79	C2	R-0784
R80	B2	R-0784
R81	B3	R-0783
R82	B2	R-0784
R83	B3	R-0783
R84	B2	R-0784
R85	B2	R-0784
R86	C3	R-0784
R87	C2	R-0784
R88	D2	R-0784
R89	A3	R-0784
R90	A2	R-0696
R91	B2	R-0720
R92	B2	R-0720
R93	B2	R-0720
R94	B2	R-0696
R95	B2	R-0696
R96	C2	R-0720
R97	C2	R-0720
R98	C2	R-0720
R99	D2	R-0696
R100	B1	R-0759
R101	B1	R-0759
R102	C1	R-0759
R103	D1	R-0759
R104	A1	R-0759
R105	B1	R-0759
R106	C1	R-0759
R107	D1	R-0759
R108	A2	R-0784
R109	A2	R-0784
R110	B2	R-0784
R111	B2	R-0784
R112	C2	R-0784
R113	C2	R-0784
R114	D2	R-0784
R115	D2	R-0784
R116	A1	R-0783
R117	C1	R-0783
R118	D1	R-0783
R119	B1	R-0783
R120	D1	R-0783
R121	B4	R-0766
R122	C4	R-0783
R123	D4	R-0768
R124	C4	R-0783
R125	D4	R-0766
R126	D4	R-0784
R127	B4	R-0766
R128	B6	R-0780
R130	B4	R-0777
R131	B4	R-0777
R132	C5	R-0821
R133	A4	R-0966
R134		R-0766

MISCELLANEOUS	
P.C. Board	14418
stiffener silk-screen ass'y	15571
P.C. Board stiffener	·9669
Nylon Bushing	H-0941
Drive rivet #38-104-06-13	H-0940



Display and Reset Parts Location Detail, Assy. 15391

10 MC DECADE UNIT – Part No. 2-11102

SCHEM: REF:	ILLUS: INDEX	DESCRIPTION	S/D STOCK #	MANUFACTURER	PART NUMBER
C401	96	Capacitor, 47 pf ±10%, 500V, dipped silver, mica	C-0533	El Menco	DM-15E-470K-500V
C402	155	Same as C401			
C403	156	Same as C401			
C404	151	Capacitor, 33 pf ±10%, 500V, dipped silver, mica	C-0531	El Menco	DM-15C-330K-500V
C405	85	Capacitor, 22 pf ±10%, 500V, dipped silver, mica	C-0529	El Menco	DM-15C-220K-500V
C406	84	Same as C405			
C407	142	Same as C404			
C408	139	Same as C401			
C409	73	Capacitor, 68 pf ±10%, 500V, dipped silver, mica	C-0535	El Menco	DM-15E-680K-500V
C410	72	Same as C409			
C411	129	Same as C401			
C412	127	Same as C401			
C413	63	Same as C404			
C414	62	Same as C404			
C415	119	Same as C401			
C416	120	Same as C401			
C417	52	Same as C404			
C418	53	Same as C404			
C419	46	Capacitor, .05 Mfd +80, −20%, 50V	C-0708	Sprague	55C23
C420	47	Same as C419			
C421	48	Same as C419			
C422	116	Same as C419			

SCHEM: REF:	ILLUS: INDEX	DESCRIPTION	S/D STOCK #
CR401	92	Diode, per Systron-Donner spec.	6-6700
CR402	90	" "	"
CR403	149	" "	"
CR404	87	" "	"
CR405	143	" "	"
CR406	80	" "	"
CR407	140	" "	"
CR408	136	" "	"
CR409	135	" "	"
CR410	133	" "	"
CR411	79	" "	"
CR412	70	" "	"

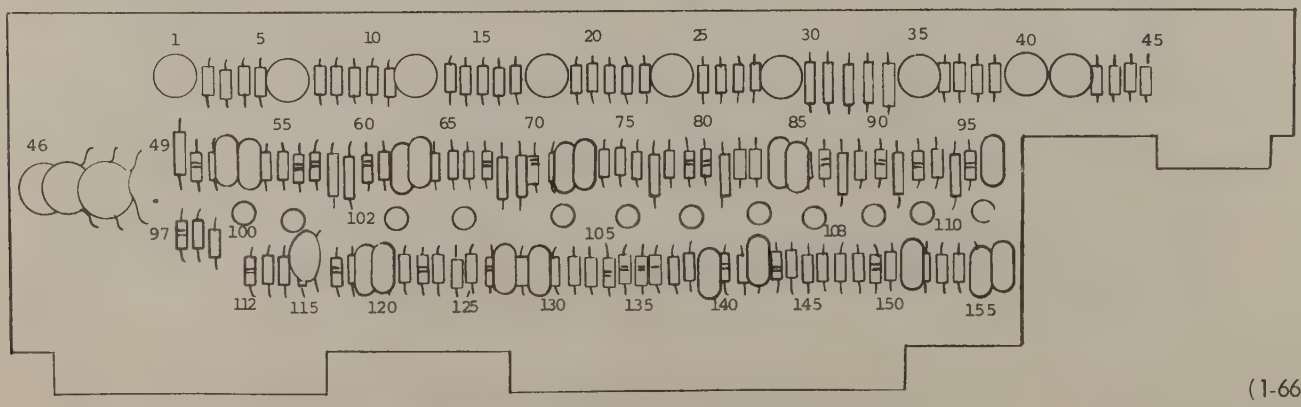
SCHEM: REF:	ILLUS: INDEX	DESCRIPTION	S/D STOCK #
CR413	134	Diode, per Systron-Donner spec.	6-6700
CR414	126	" "	"
CR415	67	" "	"
CR416	60	" "	"
CR417	122	" "	"
CR418	117	" "	"
CR419	56	" "	"
CR420	57	" "	"
CR421	50	" "	"
CR422	97	" "	"
CR423	112	" "	"
CR424	95	" "	"

Q400	41	Transistor, per Systron-Donner spec.	19-6729
Q401	40	Same as Q400	
Q402	111	Transistor, type 2N2401 (Philco)	Q-0106
Q403	110	Same as Q402	
Q404	109	Same as Q402	
Q405	108	Transistor, type 2N2779A (Philco)	Q-0129
Q406	107	Same as Q405	
Q407	106	Same as Q402	
Q408	105	Same as Q402	
Q410	103	Same as Q402	

Q411	102	Same as Q402	
Q412	101	Same as Q402	
Q413	100	Same as Q402	
Q414	6	Transistor, per Systron-Donner spec.	19-6728
Q415	24	"	"
Q416	12	"	"
Q417	18	"	"
Q418	1	"	"
Q419	35	"	"
Q420	29	"	"

RESISTOR LOCATION

SCHEM: REF:	ILLUS: INDEX	SCHEM: REF:	ILLUS: INDEX	SCHEM: REF:	ILLUS: INDEX	SCHEM: REF:	ILLUS: INDEX	SCHEM: REF:	ILLUS: INDEX	SCHEM: REF:	ILLUS: INDEX
R401	93	R416	146	R431	130	R446	51	R461	10	R476	34
R402	154	R417	145	R432	128	R447	54	R462	9	R477	30
R403	94	R418	82	R433	68	R448	118	R463	8	R478	33
R404	152	R419	141	R434	59	R449	99	R464	25	R479	32
R405	153	R420	78	R435	66	R450	98	R465	27	R480	36
R406	150	R421	138	R436	61	R451	115	R466	26	R481	7
R407	91	R422	77	R437	64	R452	114	R467	14	R482	28
R408	89	R423	69	R438	65	R453	113	R468	15	R483	13
R409	88	R424	76	R439	124	R454	42	R469	17	R484	20
R410	86	R425	71	R440	123	R455	38	R470	23	R485	2
R411	81	R426	74	R441	125	R456	44	R471	21	R486	37
R412	83	R427	75	R442	121	R457	39	R472	19	R487	22
R413	147	R428	137	R443	55	R458	45	R473	5	R488	16
R414	144	R429	132	R444	58	R459	43	R474	4	R489	3
R415	148	R430	131	R445	49	R460	11	R475	31		



Schem Ref.	Illus Index	S-D Part
CAPACITORS		
C500	C6	C-0635
C501	C5	C-0635
C502	B5	C-0533
C503	B5	C-0533
C505	B4	C-0536
C506	B4	C-0536
C508	C4	C-0635
C509	B3	C-0533
C510	B3	C-0533
C511	C3	C-0635
C512	C3	C-0635
C513	B2	C-0533
C514	B2	C-0533
C515	B1	C-0643
C516	C2	C-0708
C517	C1	C-0708
C518	C1	C-0708
C519	C1	C-0708
C520	B5	C-0672
C521	C5	C-0635
C522	C3	C-0635

Schem. Ref.	Illus Index	S-D Part.
DIODES		
CR501	B7	6700
CR502	B6	6700
CR503	C7	6700
CR504	C6	6700
CR505	B7	6700
CR506	C6	6700
CR507	C5	6700
CR508	C5	6700
CR509	C5	6700
CR510	B5	6700
CR511	B4	6700
CR512	C4	6700
CR513	C3	6700
CR514	B4	6700
CR515	B3	6700
CR516	C3	6700
CR517	C2	6700
CR518	B3	6700
CR519	B1	6700
CR520	C5	6700
CR521	B2	6700
CR522	C1	6700

Schem. Ref.	Illus. Index	S-D Parts
TRANSISTORS		
Q500	A8	15840
Q501	A8	15840
Q502	C6	14000
Q503	C5	14000
Q504	C4	14000
Q505	C4	14000
Q506	C3	14000
Q507	C3	14000
Q508	C2	14000
Q509	C2	14000
Q510	B1	Q-0075
Q511	A2	14500
Q512	A5	14500
Q513	A3	14500
Q514	A4	14500
Q515	A1	14500
Q516	A6	15840
Q517	A5	15480
Q518	C5	14000

Schem. Ref.	Illus. Index	S-D Parts
RESISTORS		
R500	B6	P/N0728
R502	B6	R-0821
R503	C6	R-0821
R504	B6	R-0616
R505	B5	R-0616
R506	C6	R-0824
R507	C6	R-0284
R508	C6	R-0821
R509	B5	R-0736
R510	B5	R-0783
R511	B4	R-0921
R512	B4	R-0821
R513	B4	R-0616
R514	B4	R-0616
R515	C5	R-0824
R516	C4	R-0824
R517	C4	R-0821
R519	C3	R-0821
R520	B3	R-0821
R521	B3	R-0821

Schem. Ref.	Illus. Index	S-D Parts
R522	A3	R-0616
R523	B2	R-0616
R524	C3	R-0824
R525	C3	R-0824
R526	C3	R-0821
R527	B2	R-0821
R528	C1	R-0742
R529	B1	R-0821
R530	B2	R-0821
R531	B2	R-0616
R532	B1	R-0616
R533	C2	R-0824
R534	C2	R-0824
R535	C2	R-0821
R536	B1	R-0883
R537	C1	R-1044
R538	A8	R-0971
R539	A7	R-0971
R540	A8	R-0696
R541	A7	R-0696

Schem. Ref.	Illus. Index	S-D Parts
R542	A8	R-0768
R543	A7	R-0768
R544	A2	R-0715
R545	A3	R-0711
A546	A3	R-0711
R547	A2	R-0711
R548	A5	R-0695
R549	A5	R-0892
R550	A5	R-0892
R551	A3	R-0695
R552	A3	R-0892
R553	A4	R-0892
R554	A4	R-0695
R555	A4	R-0892
R556	A4	R-0892
R557	A2	R-0695
R558	A2	R-0892
R559	A6	R-1499
R560	A6	R-1499
R561	A6	R-1498

Schem. Ref.	Illus. Index	S-D Parts
R562	A6	R-1498
R563	A6	R-1596
R564	A7	R-0976
R565	A2	R-0821
R566	A3	R-0821
R567	A4	R-0821
R568	A7	R-0821
R569	A2	R-0777
R570	A5	R-0777
R571	A3	R-0777
R572	A4	R-0777
R573	A1	R-0777
R574	A1	R-0807
R575	B5	R-0728
R576	B5	R-0824
R577	C5	R-0742
R578	C4	R-0742
R579	C4	R-0821

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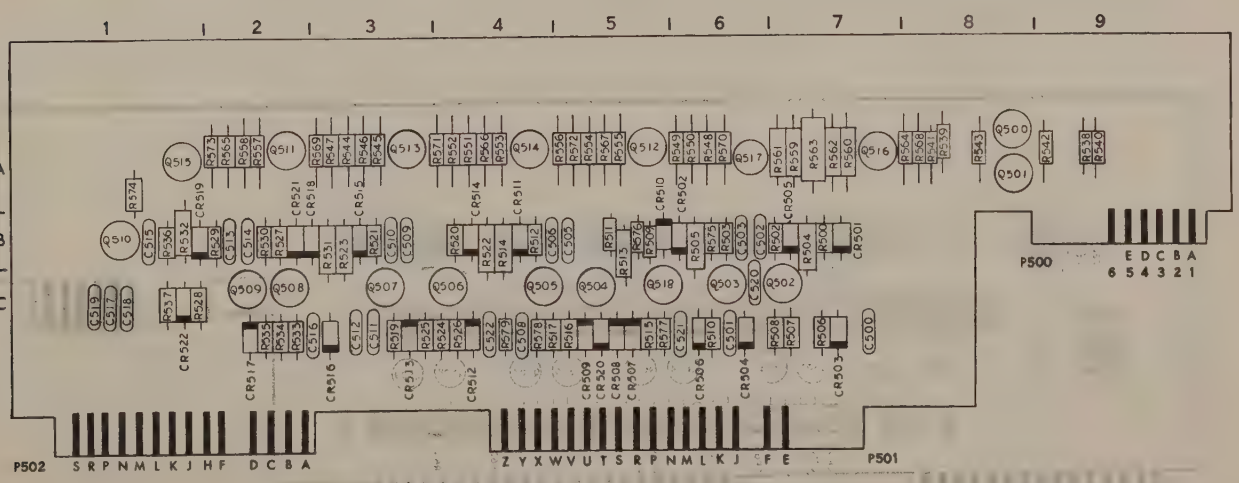


2.5 Mc Standard Decade Parts Location Detail, Assy. 13269

250 Kc Decade Composite Parts List

Schem. Ref.	Illus. Index	S-D Part
CAPACITORS		
C600	C2	C-0541
C601	C3	C-0541
C602	B3	C-0538
C603	B3	C-0538
C604	C3	C-0541
C605	A4	C-0638
C606	A4	C-0638
C607	C4	C-0541
C608	C5	C-0541
C609	B5	C-0538
C610	B5	C-0538
C611	C6	C-0541
C612	C6	C-0541
C613	B6	C-0538
C614	B6	C-0538
C615	C2	C-0708
C616	C2	C-0708
C617	C2	C-0708
C618	C6	C-0705
DIODES		
CR600	C3	6700
CR601	C3	6700
CR602	B2	6700
CR603	B3	6700
CR604	C4	6700
CR605	C4	6700
CR606	B3	6700
CR607	A4	6700
CR608	C5	6700
CR609	C6	6700
CR610	B5	6700
CR611	B5	6700
CR612	C6	6700
CR613	B6	6700
CR614	B6	6700
CR615	C2	6700
CR616	C3	6700
CR617 S	B2	6700
CR618 S	B2	6700
CR619 S	A6	6700
MISCELLANEOUS		
P. C. Board		11525
P. C. Silkscreen Ass'y		15375
P. C. Bd. Stiffener		1-9669
Nylon Bushing		H-0941
Drive Rivet		H-0940

Schem. Ref.	Illus. Index	S-D Part
RESISTORS		
R600	C2	R-0728
R601	C3	R-0728
R602	B3	R-0821
R603	B3	R-0821
R604	B2	R-0884
R605	B3	R-0884
R606	C5	R-0741
R607	C3	R-0741
R608	C3	R-0821
R609	B3	R-0824
R610	C4	R-0742
R611	A4	R-0821
R612	A4	R-0821
R613	B3	R-0884
R614	A4	R-0884
R615	C4	R-0741
R616	C4	R-0741
R617	C4	R-0821
R618	C5	R-0821
R619	C6	R-0821
R620	B5	R-0821
R621	B5	R-0821
R622	A4	R-0884
R623	B6	R-0884
R624	C5	R-0741
R625	C5	R-0741
R626	C5	R-0821
R627	C6	R-0742
R628	B6	R-0821
R629	B6	R-0821
R630	B6	R-0884
R631	B6	R-0884
R632	C6	R-0741
R633	C6	R-0741
R634	C6	R-0821
R635	B2	R-0971 N / R-0715 S
R636	B2	R-0696 N / R-0715 S
R637	B2	R-0768 N / R-0823 S
R638	B2	R-0768 N / R-0823 S
R639	B2	R-0696
R640	B2	R-0971 N / R-0785 S
R641	A1	R-01498
R642	A1	R-01498
R643	A2	R-0715
R644	A3	R-0711 N / R-0821 S
R645	A2	R-0711 N / R-0821 S
R646	A2	R-0711 N / R-0821 S
R647	A3	R-0892 N / R-0696 S
R648	A3	R-0892 N / R-0696 S
R649	A4	R-0892 N / R-0696 S
R650	A4	R-0892 N / R-0696 S
R651	A5	R-0892 N / R-0696 S
R652	A5	R-0892 N / R-0696 S
R653	A6	R-0892 N / R-0742 S
R654	A3	R-0695
R655	A4	R-0695 N / R-1235 S
R656	A5	R-0695 N / R-1235 S
R657	A6	R-0695 N / R-1235 S
R658	A1	R-01499
R659	A1	R-01499
R660	A1	R-01596
R661	A2	R-0976
R662	A6	R-0821
R663	A4	R-0821
R664	A3	R-0821
R665	B1	R-0821
R666	B1	R-0777
R667	B1	R-0777
R668	B1	R-0777
R669	B1	R-0777
R670	B1	R-0777
R671 S	B2	R-0962
R672 S	B2	R-0962
R673 S	A6	R-0821

Schem. Ref.	Illus. Index	S-D Part
TRANSISTORS		
Q600	B2	15840
Q601	B2	15840
Q602	B3	6727
Q603	B3	6727
Q604	B4	6727
Q605	B4	6727
Q606	B5	6727
Q607	B5	6727
Q608	B6	6727
Q609	B6	6727
Q610	A3	15850 N / Q-0136 S
Q611	A4	15850 N / Q-0136 S
Q612	A5	15850 N / Q-0136 S
Q613	A6	15850 N / Q-0136 S
Q614	A6	15850 N / Q-0136 S
Q615	A2	15840
Q616	A2	15840

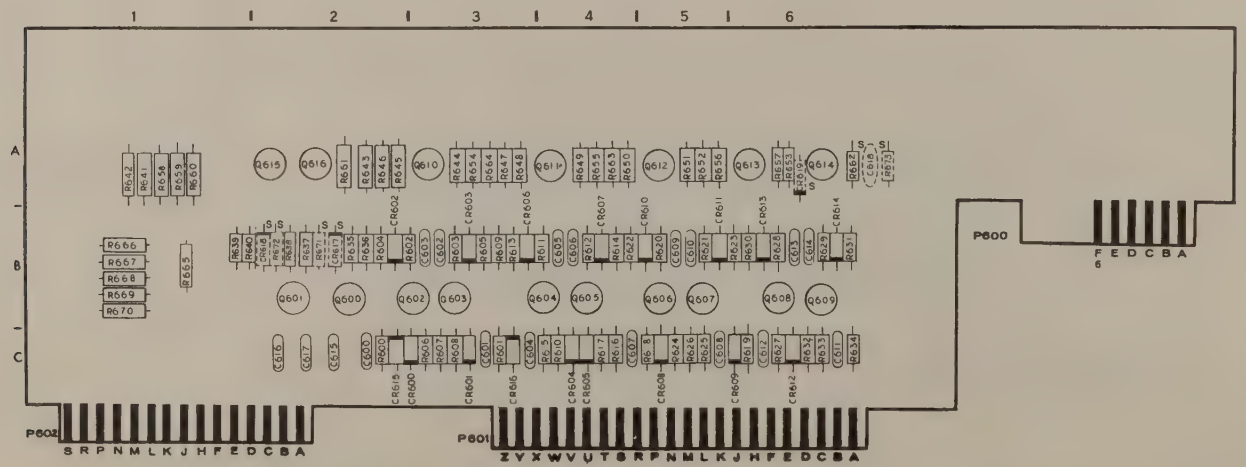
*Applicable to:

Standard Board No. 10504

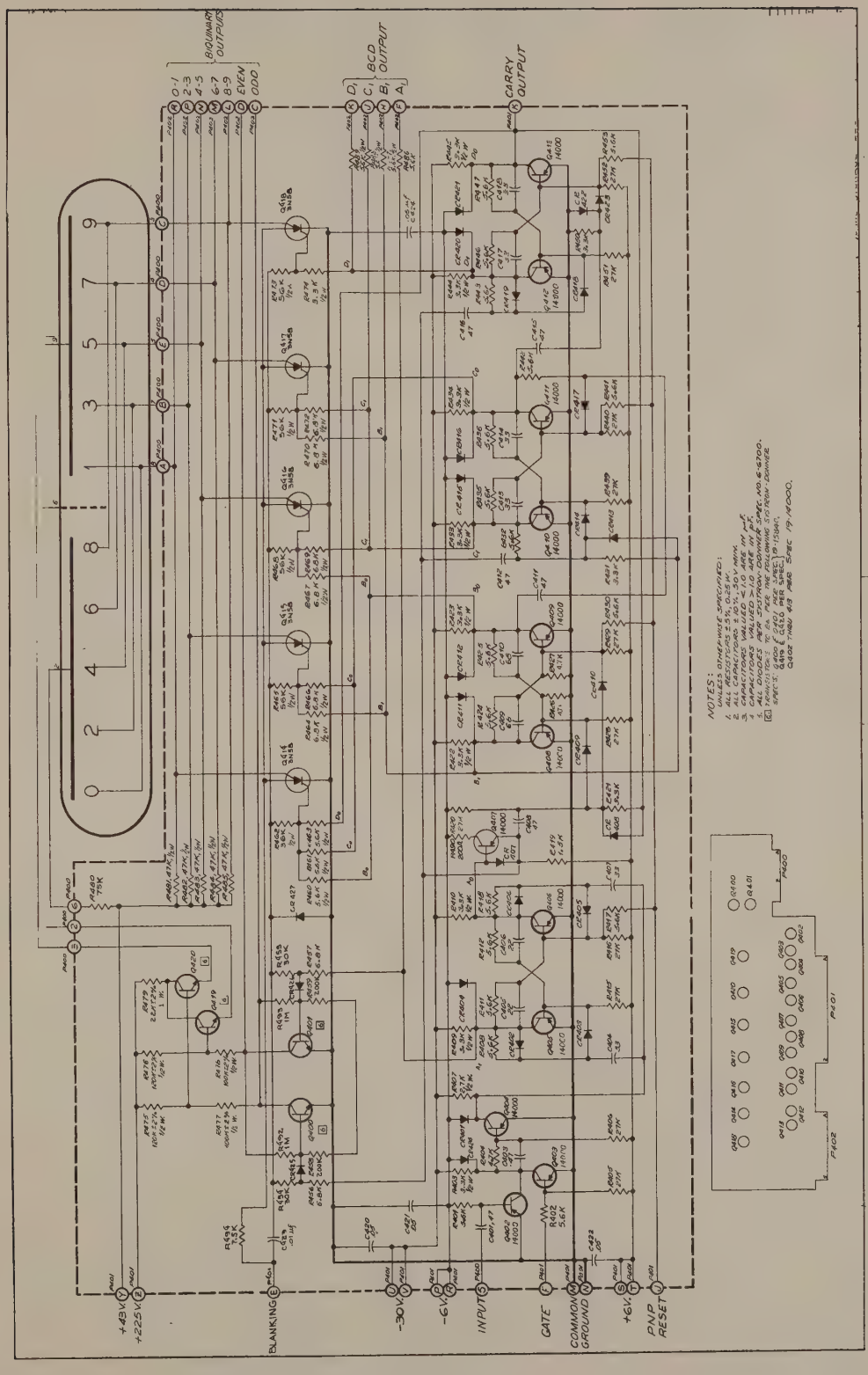
S Option Board No. 11523

NOTES:*

1—Components not marked N or S are on all boards regardless of option:
2—Components marked N are on non-storage option boards only:
3—Components marked S are on storage option boards only:
4—Refer to Master Parts List (Section 13) for component description:

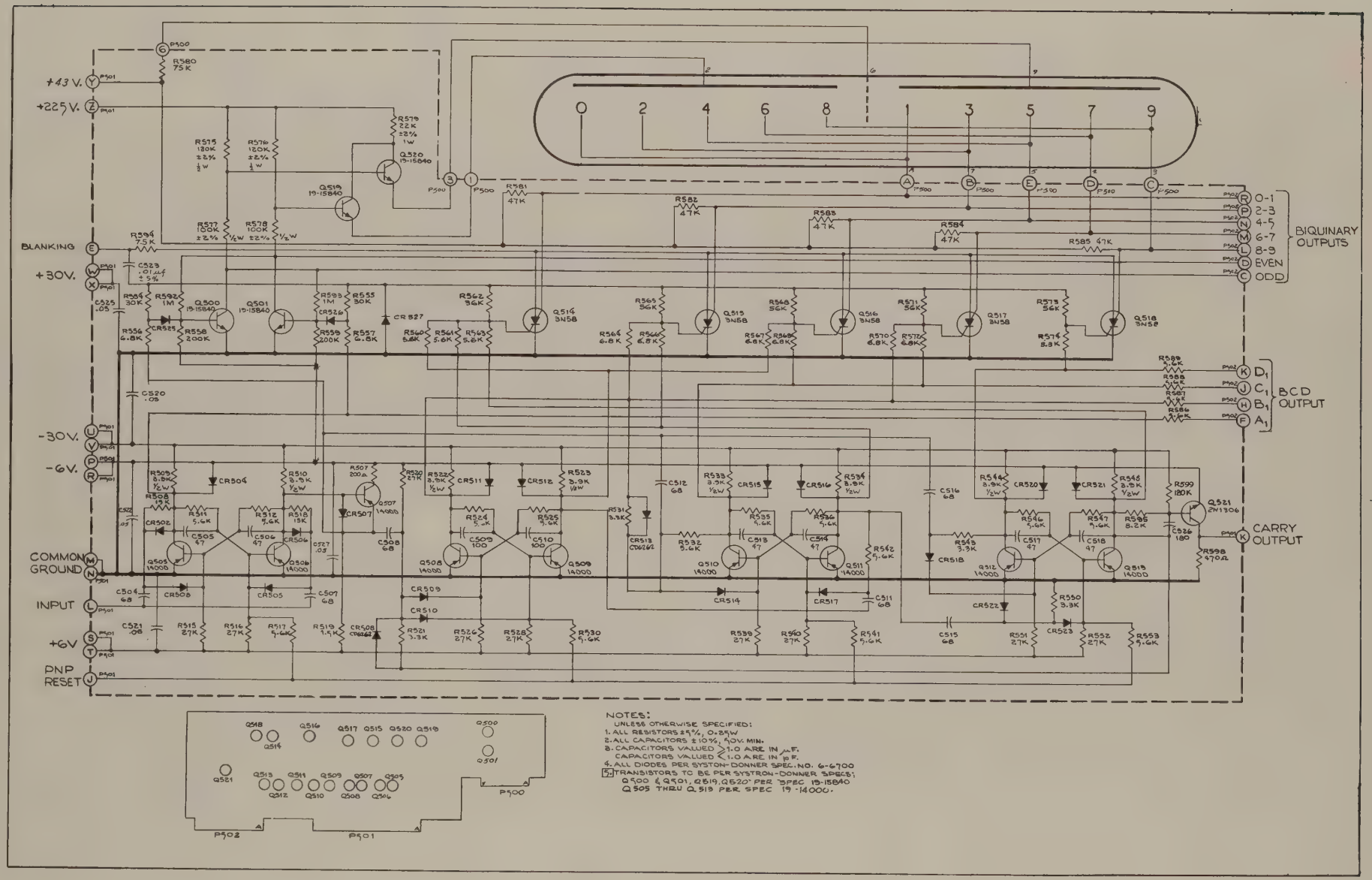


250 Kc Decade Composite Parts Location Detail,
Assy. 10504 (Std) Assy. 11523 (Storage)

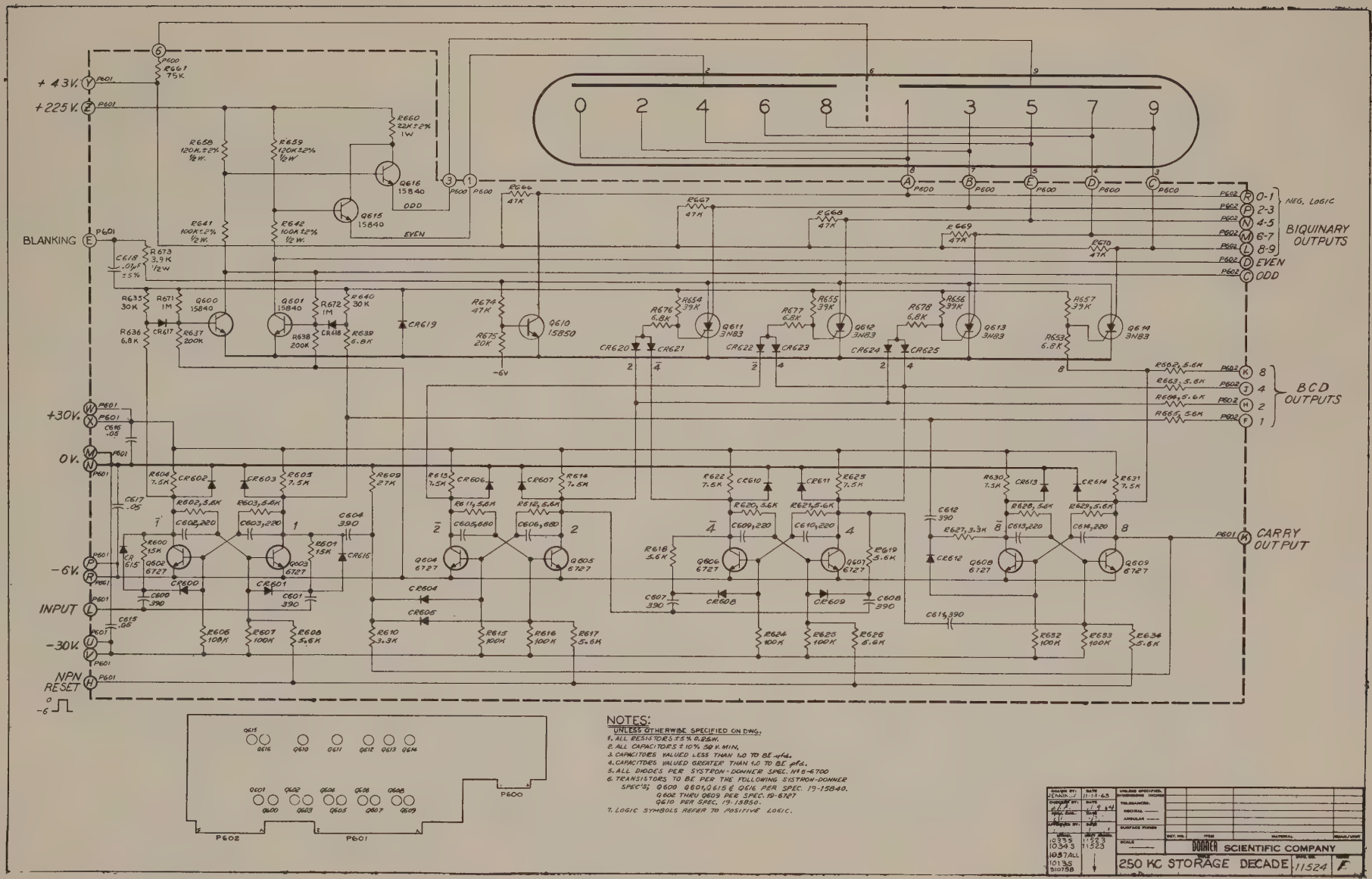


(1-66)

10 Mc Storage Decade

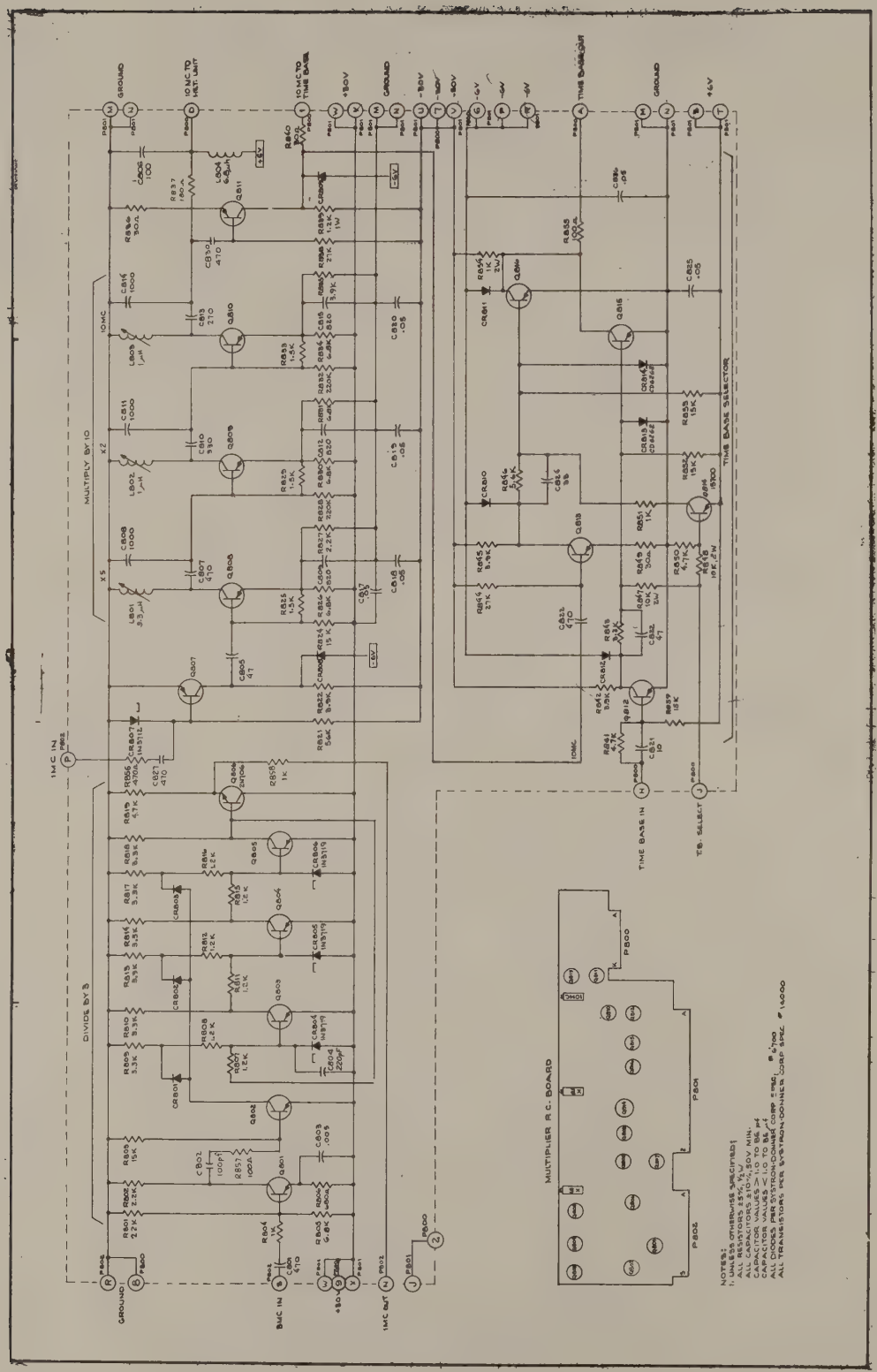


NOTES:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ±5%, 0.5W
2. ALL CAPACITORS ±10%, 50V. MIN.
3. CAPACITORS VALUED ≥1.0 ARE IN μF.
   CAPACITORS VALUED <1.0 ARE IN μμF.
4. ALL DIODES PER SYSTON-DONNER SPEC. NO. 6-6700
5. TRANSISTORS TO BE PER SYSTON-DONNER SPECS;
   Q500 & Q501, Q519, Q520 PER SPEC 19-15840
   Q505 THRU Q513 PER SPEC 19-14000.



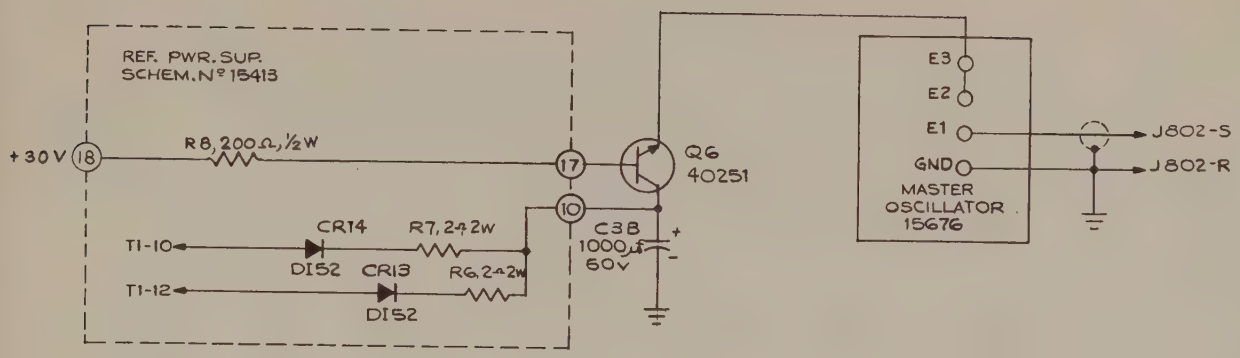
NOTES:
UNLESS OTHERWISE SPECIFIED ON DWG.
1. ALL RESISTORS ±5% O.D.S.W.
2. ALL CAPACITORS ±10% 50 V. MIN.
3. CAPACITORS VALUED LESS THAN 1.0 TO BE μfd.
4. CAPACITORS VALUED GREATER THAN 1.0 TO BE μμfd.
5. ALL DIODES PER SYSTRON-DONNER SPEC. NO. 5-6700
6. TRANSISTORS TO BE PER THE FOLLOWING SISTRON-DONNER SPEC'S; Q600 Q601, Q615 & Q616 PER SPEC. 19-15840. Q602 THRU Q609 PER SPEC. 19-6727 Q610 PER SPEC. 19-13850.
7. LOGIC SYMBOLS REFER TO POSITIVE LOGIC.

DRAWN BY: JENNIE 11-14-63
CHECKED BY:
ENGINEER BY:
APPROVED BY:
10335 10345 10857ALL 10135 51075B
DATE 1-9-64
SCALE
UNLESS SPECIFIED DIMENSIONS ARE TOLERANCES: DECIMAL ANGULAR SURFACE FINISH
DET. NO. ITEM MATERIAL REMARKS/MFR
DORRER SCIENTIFIC COMPANY
250 KC STORAGE DECADE 11524 F



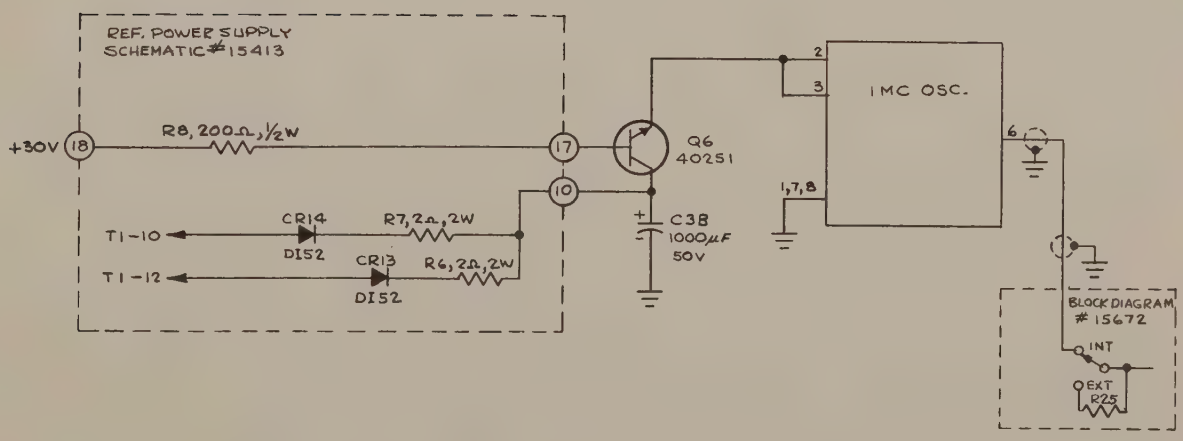
(1-66)

B Option Multiplier Divide-by-3 Schematic No. 12980



*Option B Schematic No. 15470

*Use with Dwg. 15413



*Option B 3 Schematic No. 15847

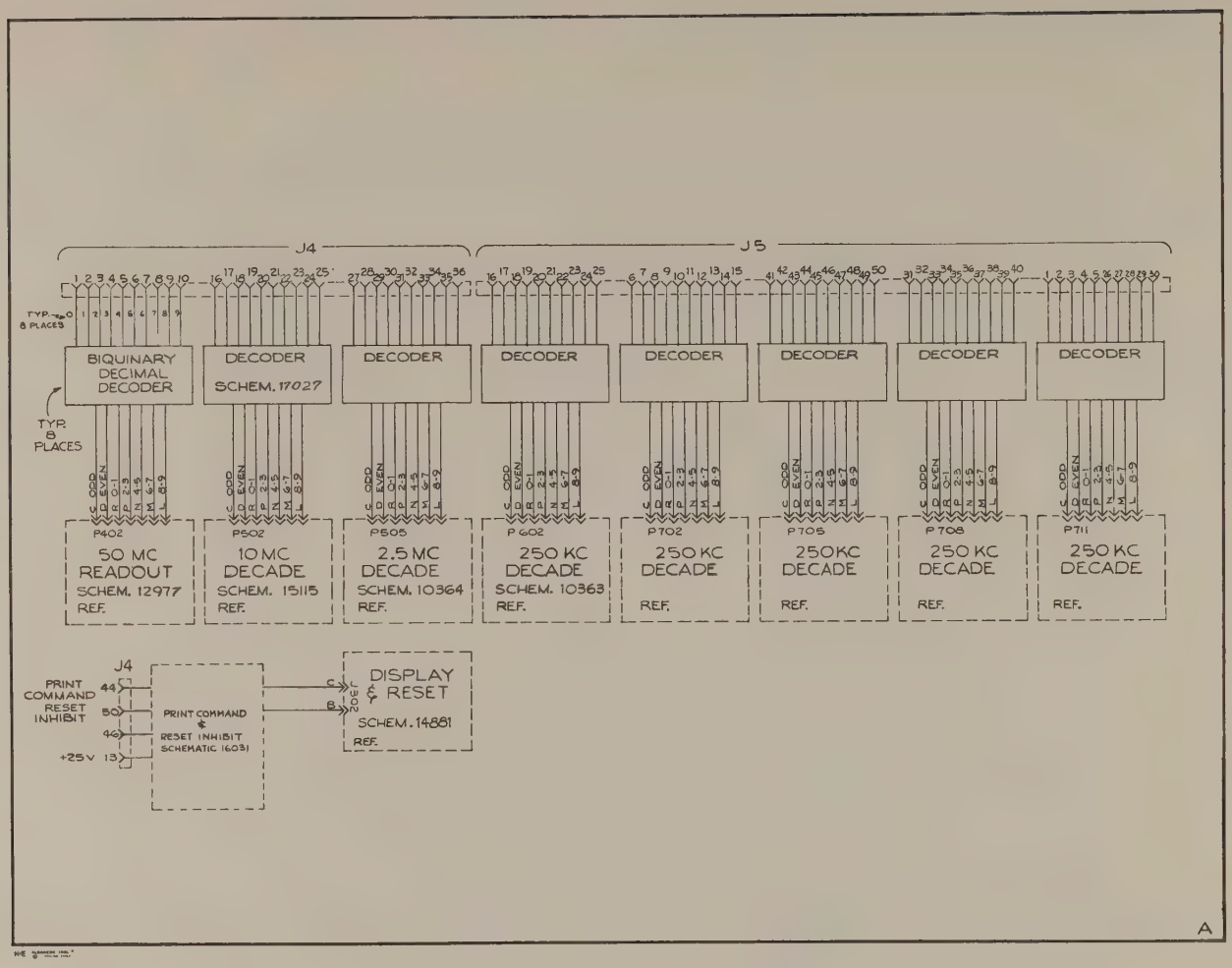


Figure 4-4 D Option Schematic No. 15683

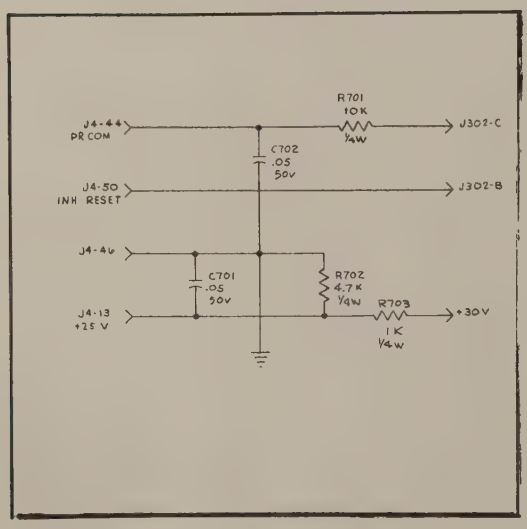


Figure 4-5 D Option Print Command

Inhibit Reset Schematic No. 16031

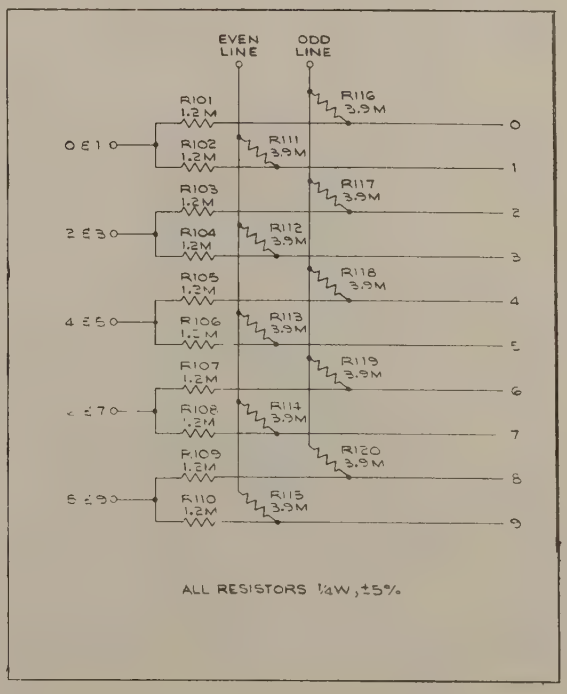


Figure 4-6 D Option BCD to 10 Line Decoder No. 17027

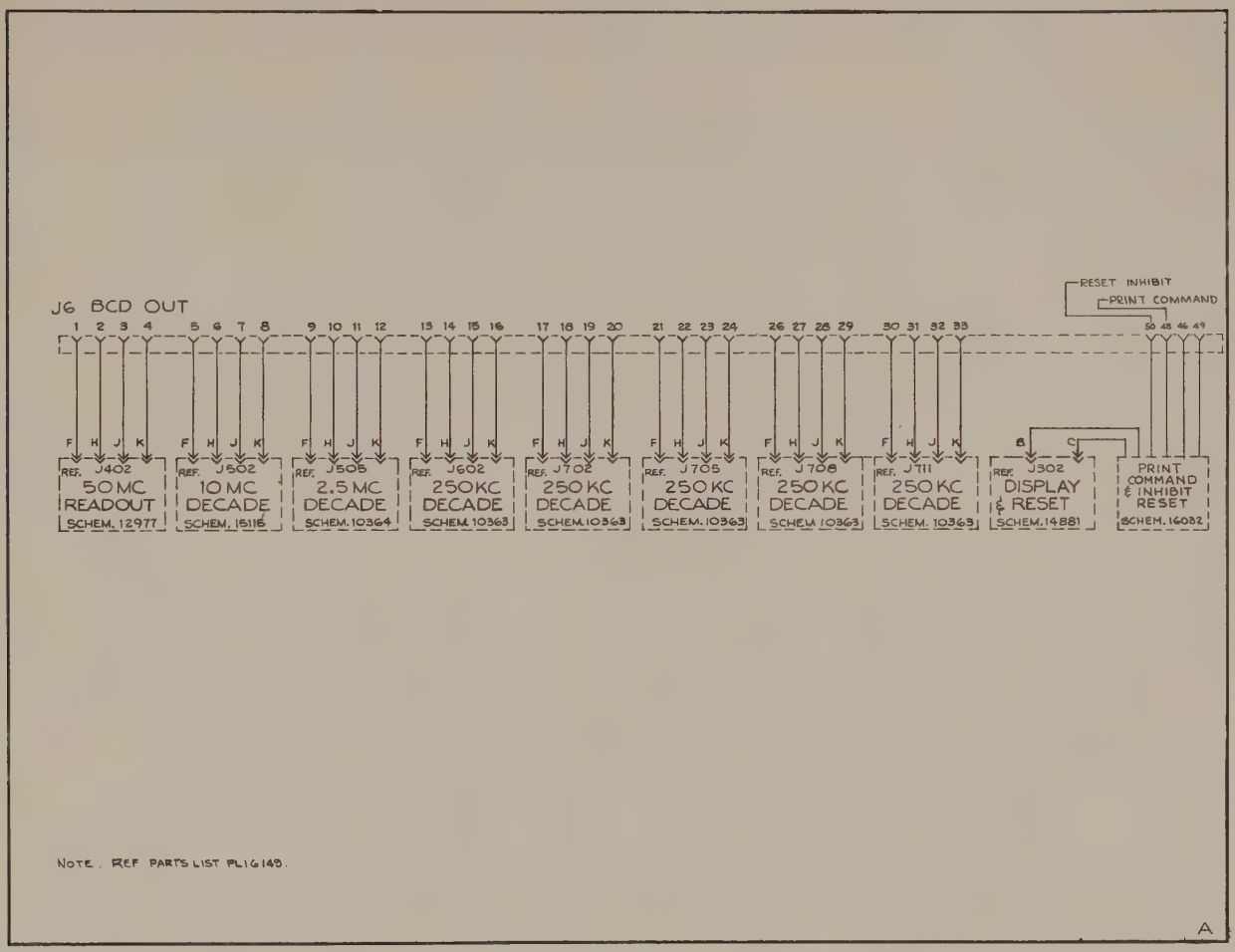


Figure 4-7 D1 Option Schematic No. 15678

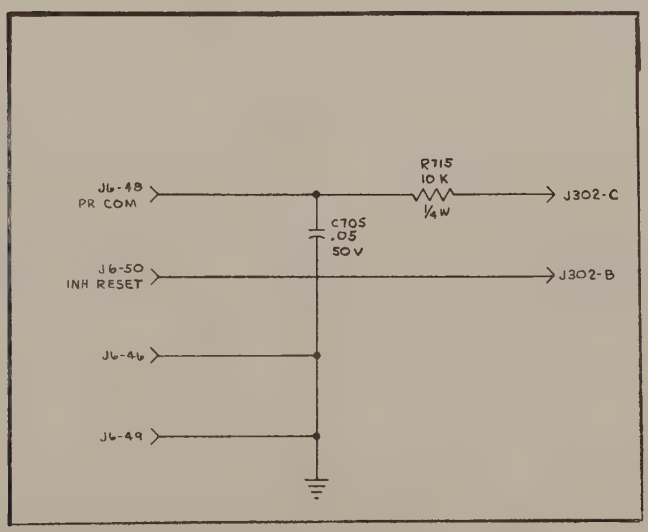


Figure 4-8 4-8 D1 Option Print Command Inhibit Reset Schematic No. 16032

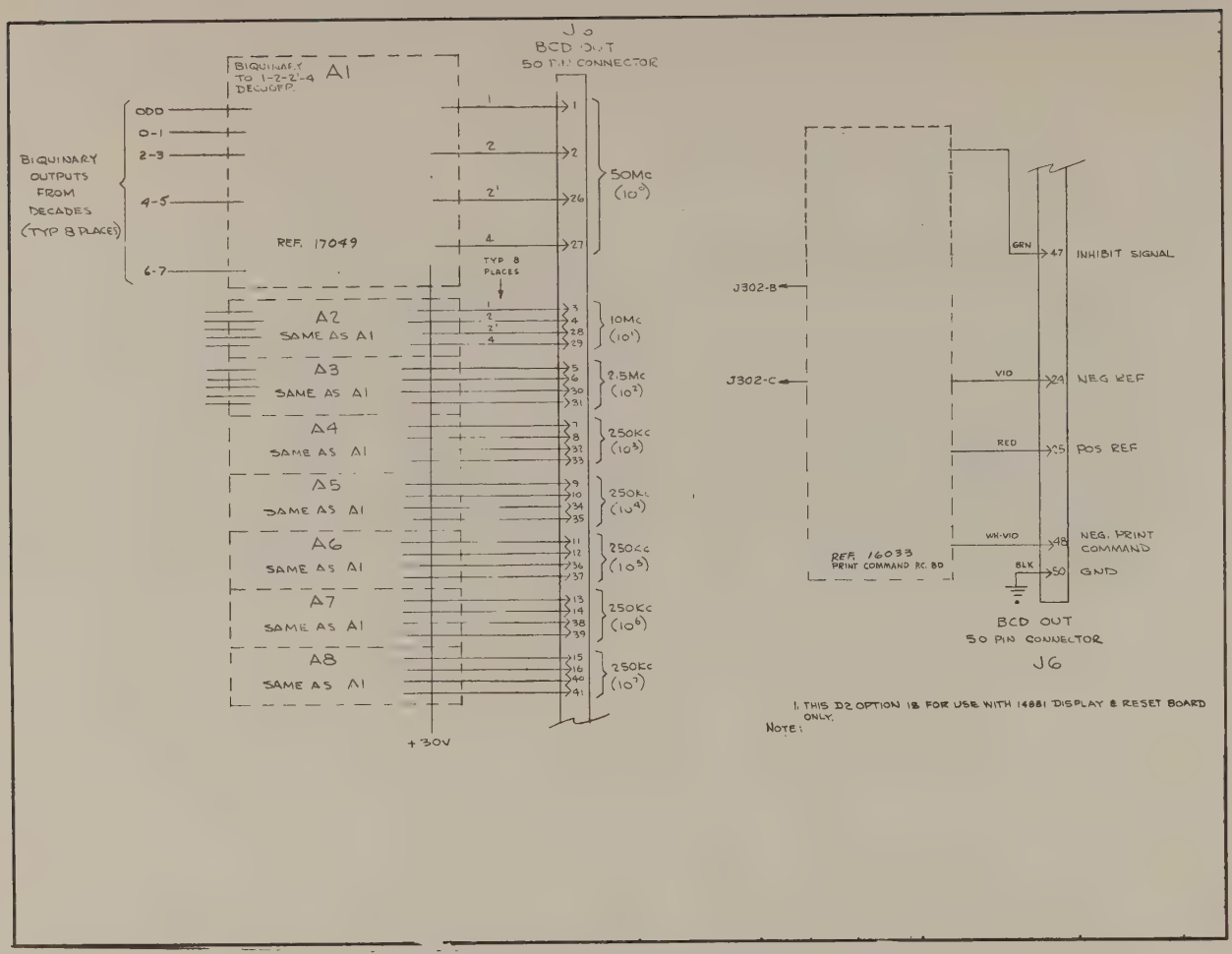


Figure 4-9 D2 Option Schematic No. 17021

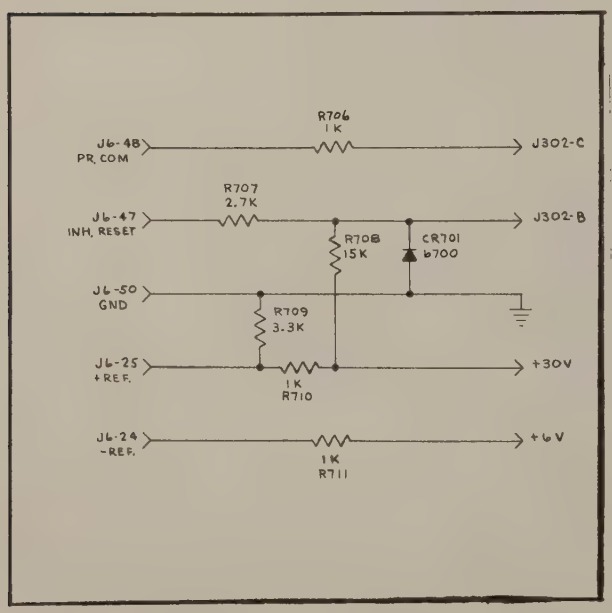


Figure 4-10 D2 Option Print Command Inhibit Reset Schematic No. 16033

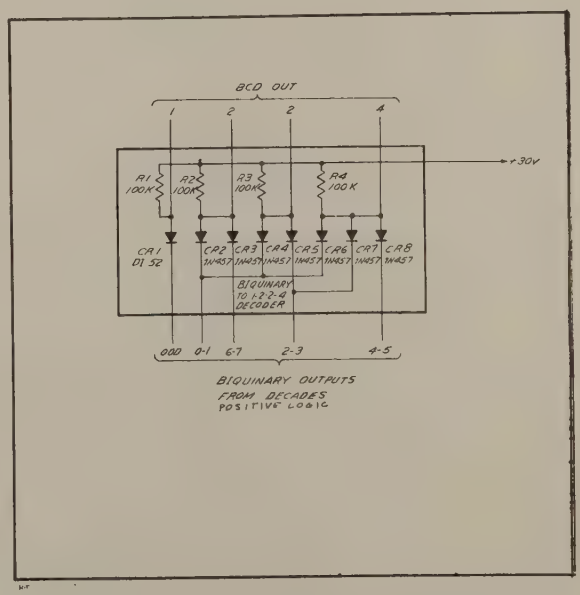
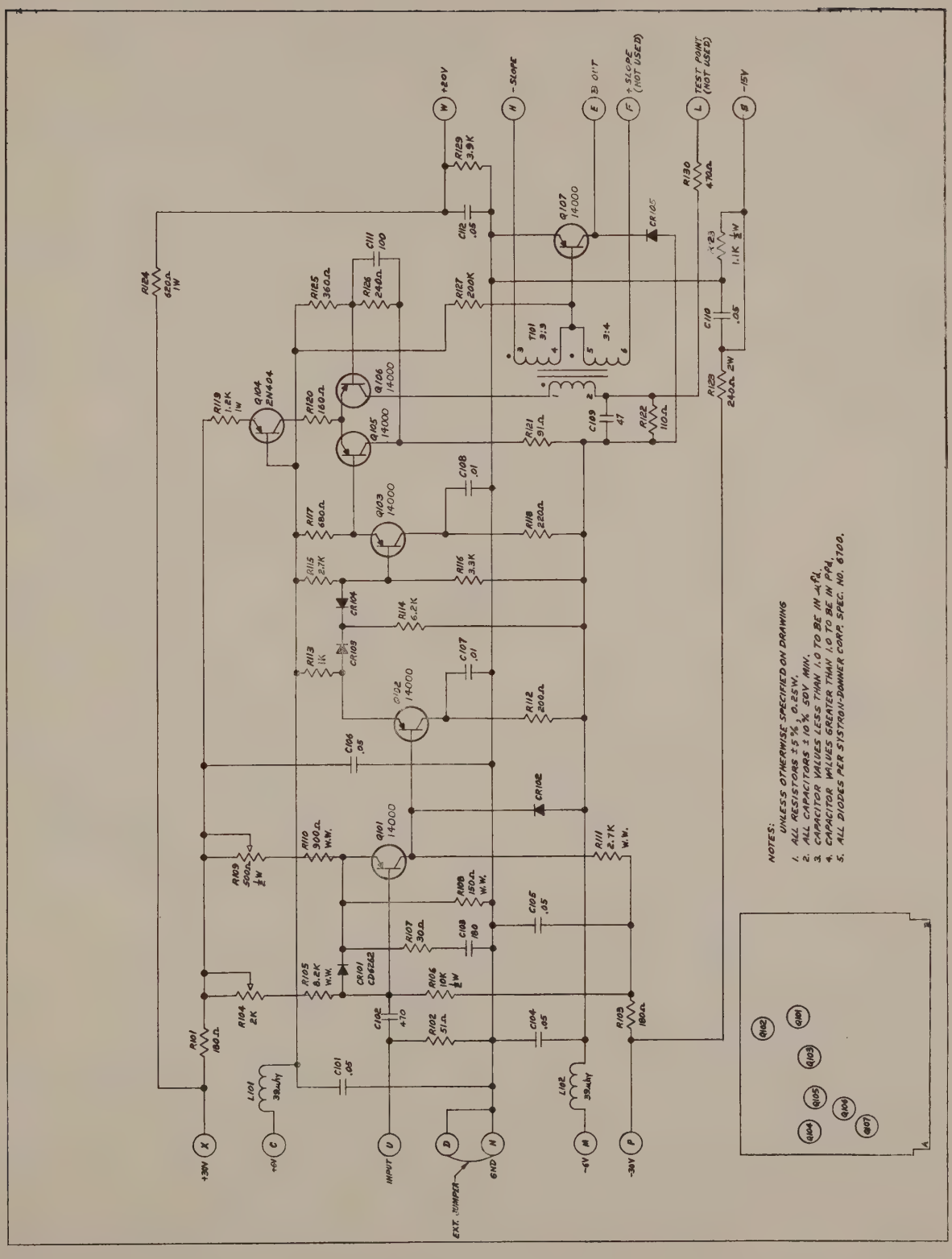
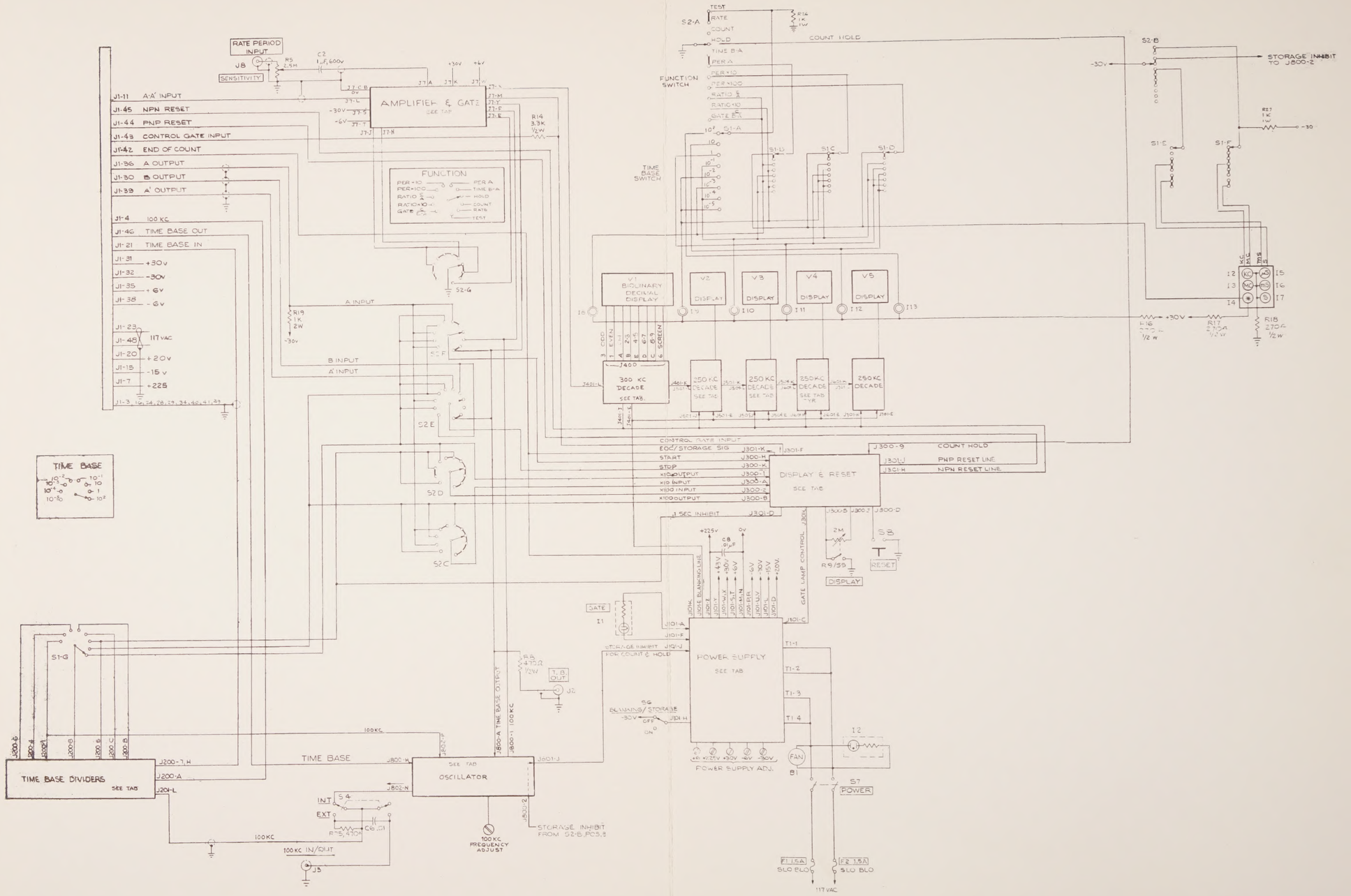


Figure 4-11 D2 Option Bi-Quinary to 1–2–2–4 Conversion No. 17049


NOTES:
UNLESS OTHERWISE SPECIFIED ON DRAWING
1. ALL RESISTORS ±5%, 0.25W.
2. ALL CAPACITORS ± 10%, 50V. MIN.
3. CAPACITOR VALUES LESS THAN 1.0 TO BE IN μFd.
4. CAPACITOR VALUES GREATER THAN 1.0 TO BE IN PFd.
5. ALL DIODES PER SYSTRON-DONNER CORP. SPEC. NO. 6100.
+20V
-SLOPE
B) OUT
+SLOPE (NOT USED)
TEST POINT (NOT USED)
-15V
+30V
+6V
INPUT
EXT. JUMPER
GND
-6V
-30V
Q101
Q102
Q103
Q104 2N404
Q105
Q106
Q107
Q108
Q109
Q110
Q111
Q112
T101
L101
L102
CR101 CD6262
CR102
CR103
CR104
CR105


RATE PERIOD INPUT
J8
SENSITIVITY
R5 2.5M
C2 1 µF, 600v
AMPLIFIER & GATE
SEE TAB
J1-11 A-A' INPUT
J1-45 NPN RESET
J1-44 PNP RESET
J1-43 CONTROL GATE INPUT
J1-42 END OF COUNT
J1-36 A OUTPUT
J1-30 B OUTPUT
J1-38 A' OUTPUT
J1-4 100 KC
J1-46 TIME BASE OUT
J1-21 TIME BASE IN
J1-31 +30v
J1-32 -30v
J1-35 +6v
J1-38 -6v
J1-23
J1-48 117 VAC
J1-20 +20v
J1-15 -15v
J1-7 +225
J1-3, 16, 24, 28, 29, 34, 40, 41, 39
FUNCTION
PER×10
PER×100
RATIO A/B
RATIO×10
GATE
PER A
TIME B-A
HOLD
COUNT
RATE
TEST
A INPUT
B INPUT
A' INPUT
S2-A
TEST
RATE
COUNT
HOLD
TIME B-A
PER A
PER×10
PER×100
RATIO A/B
RATIO×10
GATE B-A
FUNCTION SWITCH
COUNT HOLD
S2-B
STORAGE INHIBIT TO J600-E
S1-A
S1-B
S1-C
S1-D
S1-E
S1-F
TIME BASE SWITCH
V1 BIQUINARY DECIMAL DISPLAY
V2 DISPLAY
V3 DISPLAY
V4 DISPLAY
V5 DISPLAY
J400
300 KC DECADE
SEE TAB
250 KC DECADE
SEE TAB
CONTROL GATE INPUT
EOC/STORAGE SIG
START
STOP
×10 OUTPUT
×10 INPUT
×100 INPUT
×100 OUTPUT
DISPLAY & RESET
SEE TAB
J300-9 COUNT HOLD
PNP RESET LINE
NPN RESET LINE
1 SEC INHIBIT
2M
R9/95
DISPLAY
S3
RESET
TIME BASE
S1-G
S2-G
S2-F
S2-E
S2-D
S2-C
TIME BASE DIVIDERS
SEE TAB
J200-A
J200-L
100KC
TIME BASE
OSCILLATOR
SEE TAB
INT
EXT
S4
100 KC IN/OUT
J3
100 KC FREQUENCY ADJUST
STORAGE INHIBIT FROM S2-B, PC5-2
J2
1 µs OUT
SATE
I1
STORAGE INHIBIT FOR COUNT & HOLD
BLANKING/STORAGE
POWER SUPPLY
SEE TAB
POWER SUPPLY ADJ.
FAN
B1
S7 POWER
I2
F1 1.6A SLO BLO
F2 1.5A SLO BLO
117 VAC

WARRANTY

Systron-Donner instruments are warranted during a period of one year from date of shipment to original purchaser to be free from defects in material and workmanship. This warranty does not apply to vacuum tubes, except as they are warranted by tube manufacturers. The liability of Seller under this warranty is limited to replacing or repairing any instrument or component thereof which is returned by Buyer at his expense during such period and which has not been subjected to misuse, neglect, improper installations, repair, alteration, or accident. Seller shall have the right of final determination as to the existence and cause of a defect. In no event shall Seller be liable for collateral or consequential damages. This warranty is in lieu of any other warranty, express, implied or statutory, and no agreement extending or modifying it will be binding upon Seller unless in writing and signed by a duly authorized officer.

RECEIVING INSPECTION

Every Systron Donner instrument is carefully inspected and is in perfect working order at the time of shipment. Each instrument should be checked as soon as received. If the unit is damaged in any way or fails to operate, a claim should immediately be filed with the transportation company.

REPAIRS

Whenever a Systron-Donner instrument requires service, the nearest Systron-Donner representative should be contacted; all representatives will provide immediate service or arrange factory returns when necessary.

Please specify both model and serial number in all correspondence concerning Systron-Donner instruments. Address all inquiries on operation or applications to your nearest sales representative or Sales Manager, Instruments, Systron-Donner Corporation, 888 Galindo Street, Concord, California.

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